1904

CATALOGUE

BROWN & SHARPE MFG. CO.

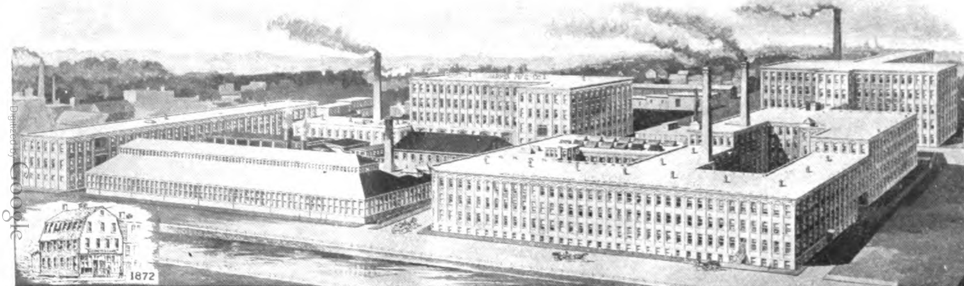
MACHINERY

AND TOOLS.

PROVIDENCE, R. I., U. S. A.

MANUFACTURERS OF

MILLING MACHINES,
GRINDING MACHINES,
AUTOMATIC GEAR CUTTING MACHINES,
SCREW MACHINES,
CUTTERS,
ACCURATE TEST TOOLS,
MACHINISTS' TOOLS.



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INDEX.

V

OF INTEREST.

The business now conducted by the Brown & Sharpe Mfg. Co. was founded in 1833 by David Brown and his son Joseph R. Brown. David Brown retired in 1841 and the business was continued by Joseph R. Brown until 1853, when Lucian Sharpe became his partner and the firm of J. R. Brown & Sharpe was formed. The Brown & Sharpe Mfg. Co. was incorporated in 1868.

The manufacture of Steel Rules and other tools of precision was begun by Joseph R. Brown in 1850 and in 1852 Samuel Darling began a similar line of work. The partnership of Darling, Brown & Sharpe was formed in 1866 and the business carried on under that name until, within a few years, the partnership was dissolved by the purchase of Mr. Darling's interest.

The Works are situated one-half mile from the business centre of Providence and are five minutes' walk northwest from the Union Railroad Station.

The Buildings are modern and especially arranged to meet the requirements of the business. The machine shops are fire-proof and the business is therefore free from danger of serious interruption and, on work entrusted to us, customers are given security against loss by fire.

Floor Area. The four main manufacturing buildings have a floor space of about 295,000 sq. ft., and the two foundries about 84,000 sq. ft. In 1853 the floor space occupied was 1,800 sq. ft.; the present buildings occupy 482,475 sq. ft. or about 11 acres.

The Machines and Tools described in this catalogue are made with the purpose that they shall be the best in their respective classes. Careful attention is constantly given to insure workmanship of the best quality. Cylindrical bearings are accurately ground; plain bearings are scraped to surface plates that are kept trued by means of master plates. All alignments are correct.

Improvements of greater or less importance are constantly being made in our machines and tools, thus adapting them to the latest requirements of machine shop practice.

All machinery is subjected to careful inspection and, when deemed requisite, to actual operation before being packed.

Should any defect become apparent in the workmanship of any of our machines or tools, we request that we be promptly notified of the same.

The Floor Space Dimensions of machines cover the extreme projections and points of travel of the various parts. The dimension at right angles to line of counter-shaft is given first.

The Speeds of Counter-shafts given in catalogue are only approximate and must be varied according to the nature of the work and the circumstances under which the tools are used.

Drawings, showing plans of our machines and counter-shafts, can be had on application by those who contemplate purchasing machinery in our line. These drawings are also sent upon receipt of order for any of our machines. They supplement the Floor Space Dimensions given in catalogue by indicating how tools can be advantageously over-
-- arranged to run by each other.

The Willcox & Gibbs Sewing Machines have been made by us for more than forty years and we refer to them as an illustration of the quality of our work.

Orders. We request our customers to use the names or numbers of tools, as printed in catalogue. This will enable us to fill orders promptly and correctly. We are often at a loss to know what is wanted when different names or descriptions are employed.

We would impress upon purchasers the advantage of ordering, if possible, articles that are made in large quantities and carried in stock, in the place of goods that vary only in one or two dimensions from these, but have to be made to order. For example, a variation of one-eighth of an inch in the size of hole of a cutter, often causes extra expense and several days' delay.

In ordering special tools to be graduated and figured, our customers are particularly requested to send a clear description and a sketch showing the exact position of figures and graduations wanted.

When goods are ordered to be sent by express, with bill to be collected on delivery, the express charge for collecting will be added. Small articles can be sent by mail when additional cost of postage is remitted. We are not responsible for losses in the mail.

The Machines and Tools described in this catalogue are usually kept in stock and will be packed and delivered at railroad or steamer in this city, without extra charge.

Verbal Orders and Instructions should be confirmed in writing.

Please address all business communications to the Company.

We carry a representative line of machine tools and a complete line of small tools at our Western Store, 16 and 18 South Clinton Street, Chicago, Ill.

We also carry representative lines of machine and small tools at our New York Office, 136 Liberty Street, Room 507. We also have a Philadelphia Office, 444 The Bourse.

Machine Tools can be ordered direct or through our representatives. List on second page of cover.

Small Tools are carried in stock and sold by instrument and hardware dealers throughout the country.

In cases where these cannot readily be procured from dealers, we will send any of our small tools upon receipt of price, to any place in the United States or Canada.

Cutters may usually be obtained at once and the delay and cost of transportation saved.

Standard Gears may also be obtained from hardware and machinists' supply dealers and are carried in stock by our agents throughout the country. See page 302.

Catalogues of the Latest Edition should be kept on hand. We are pleased to mail a copy to any address. Old catalogues should be destroyed. When reference is made to page, give date or number of catalogue found at top of first page of cover. The prices and dimensions found in this catalogue are subject to change without notice.

Pamphlets or Circulars describing the construction and use of the various machines are furnished on application.

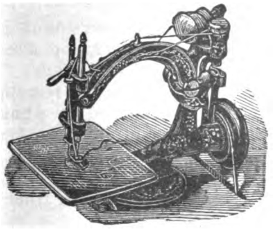
Publications on Milling and Grinding Machines, Practical Treatise on Gearing, Formulas in Gearing and Hand Book for Apprenticed Machinists may be obtained through booksellers, hardware and instrument dealers or are mailed on receipt of price, as per catalogue.

Announcements of Important Changes, notices of new machines, tools and items of general interest in relation to our business, will be published in upper left-hand corner of the last page of the "American Machinist."

Medals Awarded: London, 1862; Paris, 1867 and 1878; Vienna, 1873 and Philadelphia, 1876. At the Tennessee Centennial Exposition of 1897 we received the Gold Medal; at Paris, 1889 and 1900, and at Brussels, 1897, the Grand Prix.

As most of our machines are the outgrowth of our own wants in manufacturing, their capacity and the nature of the work they will perform, can be better appreciated, perhaps, by a visit to our works. We are always ready and glad to show our works to those who contemplate purchasing machinery or are interested in machine shop or foundry practice.

BROWN & SHARPE MFG. CO.



Willcox & Gibbs Automatic Sewing Machine

FIGURES SHOWING CAPACITY OF MACHINES.

At the head of most of the pages devoted to machinery we have placed, immediately under the number of each machine, the figures that best indicate its capacity—the object being to assist those who desire to quickly compare machines, or wish to remember or designate them by their size in a way that is customary with lathes and planing machines. In some cases this plan is novel, so we have repeated the figures of capacities below the illustrations of the machines. For example: the illustration of one of the Grinding Machines is headed, No. 1, 8" x 24", Universal Grinding Machine, and is followed by the words, "The centres swing 8" in diameter and take 24" in length."

CONSTRUCTION NUMBERS.

In ordering tools, attachments or duplicate parts of machines, it is often desirable to give the construction number of the machine.

These numbers may be located as follows:

Universal and Plain Milling Machines: above spindle on frame, top front of table, top front of knee.

Vertical Spindle Milling Machines: No. 2, top front of table, top front of knee, front of upper box on spindle head; No. 5, top front of table and top front of ways.

Universal Grinding Machines: top front of swivel table.

Plain Grinding Machines: top front side of guide on table.

Surface Grinding Machines: No. 2, top front of upright, top of table; No. 3, top front of wheel slide.

No. 1 Tool Grinding Machine: top of rest support.

No. 2 Cutter Grinding Machine and No. 3 Universal Cutter and Reamer Grinder: spot, top of guide bar bracket.

Automatic Gear Cutting Machines: top left-hand side of upright, outer support for work arbor.

Plain and Wire Feed Screw Machines: front side of front box.

Automatic Screw Machines: front side of rear box.

DIMENSIONS OF UNIVERSAL MILLING MACHINES.

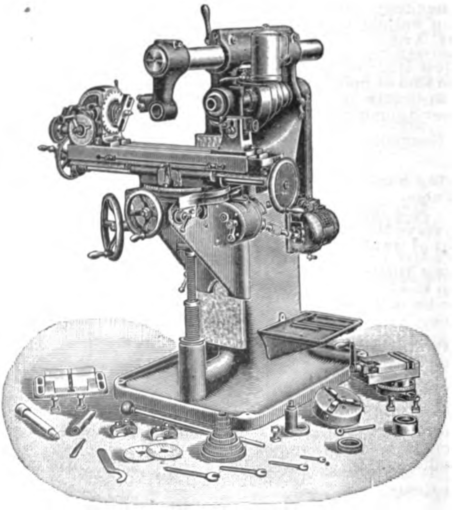
No. of Machine.	1	1 1-2	2	2A	3	4
No. of Taper Hole in Spindle.	10	10	10	10	11	11
Distance from Centre of Spindle to O. H. Arm.	5 1-2″	5 1-2″	5 1-2″	5 1-2″	6 3-8″	7 1-4″
Greatest Distance from End of Spindle to Centre in Arbor Support.	14″	16 1-2″	16 1-2″	16 1-2″	18 1-2″	21″
Back Geared.	No	Yes	Yes	Yes	Yes	Yes
Working Surface of Table.	32 3-4″ x 6 1-2″	32 3-4″ x 6 1-2″	37″ x 8 1-4″	37″ x 8 1-4″	45 1-2″ x 10″	54 1-2″ x 11 1-2″
Transverse Movement of Table.	7 1-2″	7 1-2″	7 1-2″	7 1-2″	8 1-2″	9 1-2″
Greatest Distance from Centre of Spindle to Top of Table.	18″	18″	17 1-2″	17 1-2″	19″	19″
Length of Automatic Feed.	20″	20″	23″	23″	28″	33 1-2″
No. of Changes of Feed.	12	20	20	12	20	20
Variations in Feed to one Rev. of Spindle.	.005″ to .100″	.003″ to .120″	.003″ to .120″	.001″ to .400″	.004″ to .160″	.004″ to .200″
Index Centres Swing.	10″	10″	10″	10″	12″	14″
Index Centres Take.	16″	16″	19 1-2″	19 1-2″	26″	32″
Net Weight.	2225 lbs.	2485 lbs.	2585 lbs.	2750 lbs.	4030 lbs.	5000 lbs.
Floor Space.	68″x 63″	69″x 68″	77″x 75″	77″x 75″	93″x 86″	110″x 92″
Price.						

No. 1

20 in. x 7 1-2 in. x 18 in.

UNIVERSAL MILLING MACHINE.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Sept. 10, Nov. 12, 1901; Jan. 13, 1903; Others pending.



The table has an automatic longitudinal feed of 20″; a transverse movement of 7 1-2″ and can be lowered 18″ from centre of spindle.

The centres swing 10″ in diameter and take 16″ in length.

No. 1 20 in. x 7 1-2 in. x 18 in.
UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt, giving, with 3 speeds of counter, 8 changes of speed direct, from 56 to 333 revolutions per minute and 4 reverse, from 65 to 292 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 14". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor, etc., as well as an adjustable centre.

The Table, including oil pans and channels, is 35 3-4" long, 6 1-2" wide, has a working surface 32 3-4" x 6 1-2", a T slot 5-8" wide, a transverse movement of 7 1-2" and can be lowered 18" from centre of spindle. Arc of swing 280°.

The Elevating Screw is telescopic.

The Feed of table, of 20", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle, and, being driven from the centre, can be used with table clamped at any angle to 53 degrees either side of zero. There are 12 changes of feed, evenly graded from .005" to .100" to one revolution of spindle. The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 10" in diameter and take 16" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded, and has a No. 10 taper hole. The straight hole through spindle, at end of taper, is 1 1-16" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 380.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep, and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belts, and should run about 90 and 120 revolutions per minute direct, and 105 reverse.

Weight of machine ready for shipment, about 2775 lbs.

Net Weight, about 2225 lbs. **Floor Space**, 68"x 63".

Dimensions of box for shipment, 53"x 35"x 67".

Price includes No. 2 Swivel Vise, change gears, index plates and tables explaining the use of same, 6" 3-jawed chuck, "E" collet, centre rest, raising block, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

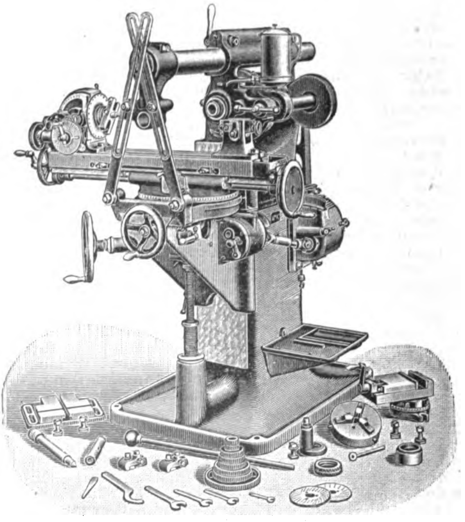
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 1 1-2

20 in. x 7 1-2 in. x 18 in.

UNIVERSAL MILLING MACHINE.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Sept. 10, Nov. 12, 1901; Jan. 30, 1903; Others pending.



The table has an automatic longitudinal feed of 20″; an automatic transverse movement of 7 1-2″ and can be lowered 18″ from centre of spindle.

The centres swing 10″ in diameter and take 16″ in length.

No. 1 1-2 20 in. x 7 1-2 in. x 18 in.
UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt, and is back geared, giving, with 3 speeds of counter, 16 changes of speed direct, from 16 to 318 and 8 reverse, from 17 to 290 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16 1-2". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position, milling can be done to 16" from face of column.

The Table, including oil pans and channels, is 35 3-4" long, 7" wide, has a working surface 32 3-4" x 7", a T slot 5-8" wide, an automatic transverse movement of 7 1-2". Can be lowered 18" from centre of spindle. Arc of swing 280°.

The Elevating Screw is telescopic.

The Feed of table, of 20", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle, and, being driven from the centre, can be used with table clamped at any angle to 53 degrees either side of zero. There are 20 changes of feed evenly graded from .003" to .120" to one revolution of spindle. The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 10" in diameter and take 16" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded and has a No. 10 taper hole. The straight hole through spindle, at end of taper, is 1 1-16" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 380.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belts, and should run about 144 and 175 revolutions per minute direct, and 160 reverse.

Weight of machine ready for shipment, about 3100 lbs.

Net Weight, about 2485 lbs. **Floor Space**, 69"x 68".

Dimensions of box for shipment, 56" x 35" x 67".

Price includes No. 2 Swivel Vise, change gears, index plates and tables explaining the use of same, 6" 3-jawed chuck, "E" collet, centre rest, raising block, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

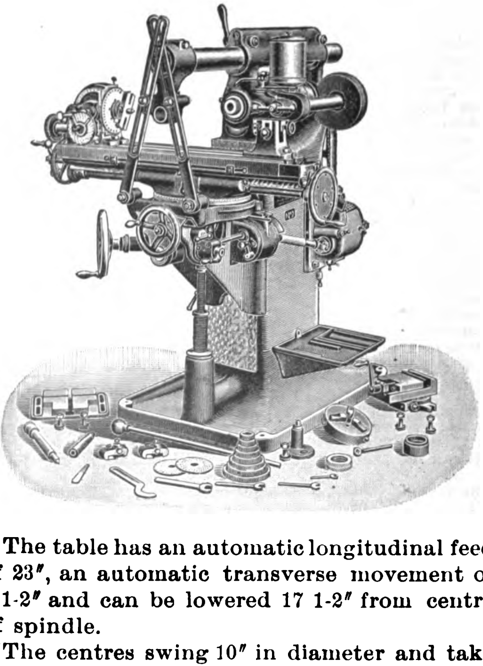
No. 2

23 in. x 7 1-2 in. x 17 1-2 in.

UNIVERSAL MILLING MACHINE.

With Hand or Power Vertical Feed.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Sept. 10, Nov. 12, 1901; Jan. 13, 1903; Others pending.



The table has an automatic longitudinal feed of 23″, an automatic transverse movement of 7 1-2″ and can be lowered 17 1-2″ from centre of spindle.

The centres swing 10″ in diameter and take 19 1-2″ in length.

No. 2 23 in. x 7 1-2 in. x 17 1-2 in.
UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt and is back geared, giving, with 3 speeds of counter, 16 changes of speed direct, from 16 to 318 revolutions per minute and 8 reverse, from 17 to 290 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16 1-2". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor, etc., as well as an adjustable centre.

Arm Braces are furnished, and with these in position, milling can be done to 16" from face of column.

The Table, including oil pans and channels, is 40" long, 8 1-4" wide, has a working surface 37" x 8 1-4", 2 T slots 5-8" wide, an automatic transverse movement of 7 1-2" and can be lowered 17 1-2" from centre of spindle. Arc of swing, 280°.

The Elevating Screw is telescopic.

The Feed of table, of 23", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle, and, being driven from the centre, can be used with table clamped at any angle to 53 degrees either side of zero. There are 20 changes of feed evenly graded from .003" to .120" to one revolution of spindle. The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 10" in diameter and take 19 1-2" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded and has a No. 10 taper hole. The straight hole through spindle, at end of taper, is 1 1-16" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 380.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belts and should run about 144 to 175 revolutions per minute direct and 160 reverse.

Weight of machine ready for shipment, about 3200 lbs.

Net Weight, about 2585 lbs. **Floor Space**, 77" x 75."

Dimensions of box for shipment, 56" x 36" x 67".

Price includes No. 2 Swivel Vise, change gears, index plates and tables explaining the use of same, 6" 3-jawed chuck, "El" collet, centre rest, raising block, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $ **Price, with Power Vertical Feed, $**

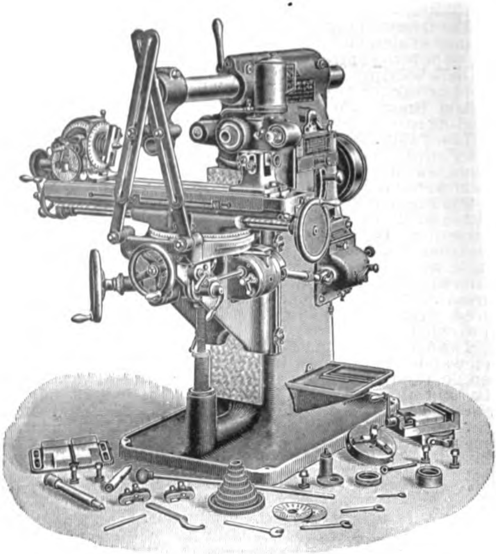
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 2-A

23 in. x 7 1-2 in. x 17 1-2 in.

UNIVERSAL MILLING MACHINE.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Nov. 12, 1901; Jan. 13, 1903; Others pending.



The table has an automatic longitudinal feed of 23″, an automatic transverse movement of 7 1-2″ and can be lowered 17 1-2″ from centre of spindle.

The centres swing 10″ in diameter and take 19 1-2″ in length.

No. 2-A 23 in. x 7 1 2 in. x 17 1-2 in.
UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole. It is driven by a single pulley, 11" diameter for 3" belt and is back geared, giving 16 changes of speed in either direction, from 15 to 376 revolutions per minute. Changes obtained by gearing. Speeds in geometrical progression. Driving pulley runs at constant speed.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16 1-2". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position, milling can be done to 16" from face of column.

The Table, including oil pans and channels, is 40" long, 8 1-4" wide, has a working surface 37" x 8 1-4", 2 T slots. 5-8" wide, an automatic transverse movement of 7 1-2" and can be lowered 17 1-2" from centre of spindle. Arc of swing 280°.

The Elevating Screw is telescopic.

The Feed of table, of 23", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle and, being driven from the centre, can be used with table clamped at any angle to 53 degrees either side of zero. There are 12 changes of feed in geometrical progression, from 1-2" to 6" per minute. Range for small mills, .001" to .016" per revolution of spindle; large mills, .033" to .400". The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 10" in diameter and take 19 1-2" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded and has a No. 10 taper hole. The straight hole through spindle, at end of taper, is 1 1-16" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 382.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 2 friction pulleys 14" in diameter for 3 1-2" belts and should run about 275 revolutions per minute in either direction.

Weight of machine ready for shipment, about 3400 lbs.

Net Weight, about 2750 lbs. **Floor Space**, 77" x 75".

Dimensions of box for shipment, approximate, 49" x 36" x 67".

Price includes change gears, index plates and tables explaining the use of same, 6" 3-jawed chuck, No. 2 Swivel Vise, "E" collet, centre rest, raising block, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $ Price, with Power Vertical Feed, $

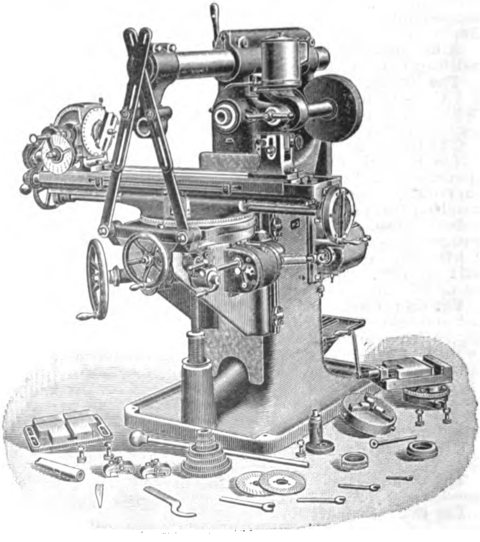
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 3

28 in. x 8 1-2 in. x 19 in.

UNIVERSAL MILLING MACHINE.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Sept. 10, Nov. 12, 1901; Jan. 13, 1903; Others pending.



The table has automatic feeds as follows: longitudinal, 28″; transverse, 8 1-2″; vertical, 19″.

The centres swing 12″ in diameter and take 26″ in length.

No. 3 28 in. x 8 1-2 in. x 19 in.

UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 11 taper hole.

The Cone has 4 steps for 3 1-2" belt and is back geared, giving with 3 speeds of counter, 16 changes of speed direct, from 13 to 392; and 8 reverse, from 14 to 353 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 6 3-8"; greatest distance from end of spindle to centre in arbor support, 18 1-2". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position, milling can be done to 18" from face of column.

The Table, including oil pans and channels, is 50 1-4" long, 10" wide, has a working surface 45 1-2" x 10", 3 T slots 5-8" wide, an automatic transverse movement of 8 1-2" and an automatic vertical movement of 19". Arc of swing 280°.

The Elevating Screw is telescopic.

The Feed of table, of 28", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle, and, being driven from the centre, can be used with table clamped at any angle to 50 degrees either side of zero. There are 20 changes of feed, evenly graded from .004" to .160" to one revolution of spindle. The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 12" in diameter and take 26" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded and has a No. 11 taper hole. The straight hole through spindle at end of taper is 1 1-4" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 380.

The Vise swivels and has a graduated base. The jaws are hardened, 6 1-8" wide, 1 9-16" deep and will open 3 5-8".

The Counter-shaft has 3 friction pulleys, two 12" and one 14" in diameter, for 3 1-2" and 4' belts and should run about 198 and 158 revolutions per minute direct and 178 reverse.

Weight of machine ready for shipment, about 4825 lbs.

Net Weight, about 4030 lbs. **Floor Space**, 93"x 86".

Dimensions of box for shipment, 65"x 41"x 73".

Price includes No. 3 Swivel Vise, change gears, index plates and tables explaining the use of same, 8" 3-jawed chuck, "G" collet, centre rest, raising block, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

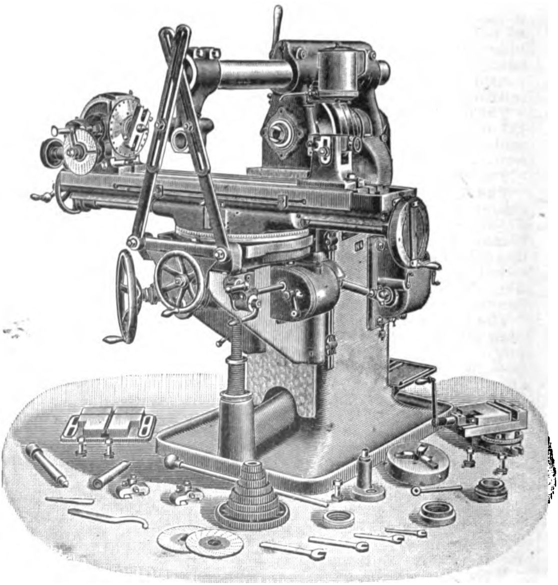
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 4

33 1-2 in. x 9 1-2 in. x 19 in.

UNIVERSAL MILLING MACHINE.

Patented Feb. 14, May 23, 1893; Aug. 29, 1899; Sept. 10, Nov. 12, 1901; Jan. 13, 1903; Others pending.



The table has automatic feeds as follows: longitudinal, 33 1-2″; transverse, 9 1-2″; vertical, 19″.

The centres swing 14″ in diameter and take 32″ in length.

No. 4 33 1-2 in. x 9 1-2 in. x 19 in.
UNIVERSAL MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 11 taper hole.

The Cone has 4 steps for 3 1-2" belt and is back geared, giving, with 3 speeds of counter, 16 changes of speed direct, from 10 to 452; and 8 reverse, from 12 to 386 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 7 1-4"; greatest distance from end of spindle to centre in arbor support, 21". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position, milling can be done to 19 1-2" from face of column.

The Table, including oil pans and channels, is 59 3-4" long, 11 1-2" wide, has a working surface 54 1-2" x 11 1-2", 3 T slots, 3-4" wide, an automatic transverse movement of 9 1-2", an automatic vertical movement of 19". Arc of swing, 276°.

The Elevating Screw is telescopic.

The Feed of table, of 33 1-2", is positive and automatic in either direction. It can be changed by a simple movement of lever on front of saddle, and, being driven from the centre, can be used with table clamped at any angle to 48 degrees either side of zero. There are 20 changes of feed, evenly graded from .004" to .200" to one revolution of spindle. The table feed screw is not splined. A quick return for the table is provided.

The Spiral Head and Foot-stock Centres swing 14" in diameter and take 32" in length. The head can be set at any angle from 10 degrees below the horizontal to 5 degrees beyond the perpendicular. The front end of spindle is threaded and has a No. 11 taper hole. The straight hole through spindle at end of taper is 1 1-4" in diameter. By means of the raising block the head can be set at any angle on table. The foot-stock centre can be raised vertically and set at an angle in a vertical plane.

Differential Indexing provides for all divisions from 1 to 380.

The Vise swivels and has a graduated base. The jaws are hardened, 6 1-8" wide, 1 9-16" deep and will open 3 5-8".

The Counter-shaft has 3 friction pulleys, two 14" and one 16" in diameter for 4" belts, and should run about 225 and 175 revolutions per minute, direct; and 200 reverse.

Weight of machine ready for shipment, about 6000 lbs.

Net Weight, about 5000 lbs. **Floor Space**, 110" x 92".

Dimensions of box for shipment, 73" x 46" x 72".

Price includes No. 3 Swivel Vise, change gears, index plates, and tables explaining the use of same, 9" 3-jawed chuck, "G" collet, centre rest, raising block, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

DIMENSIONS OF PLAIN MILLING MACHINES.

No. of Machine.	00	0	1	1B	2	2B
No. of Taper Hole in Spindle.	9	9	10	10	10	10
Distance from Centre of Spindle to O. H. Arm.	5 1-8″	5 1-8″	5 1-2″	5 1-2″	5 1-2″	5 1-2″
Greatest Distance from End of Spindle to Centre in O. H. Arm or Arbor Support.	10 1-2″	10 1-2″	16″	16 1-2″	16″	16 1-2″
Back Geared.	No	No	No	No	Yes	Yes
Working Surface of Table.	16″ x 5 1-2″	20″ x 8″	32″ x 10″	32″ x 10″	34″ x 10″	34″ x 10″
Transverse Movement of Table.	4 1-4″	4 1-4″	6 1-2″	7 1-2″	6 1-2″	7 1-2″
Greatest Distance from Centre of Spindle to Top of Table.	7 1-2″	14 1-2″	18 1-2″	18″	18 1-2″	18″
Length of Automatic Feed.		16″	24″	24″	28″	28″
No. of Changes of Feed.		8	8	12	12	12
Variations in Feed to one Rev. of Spindle.		.005″ to .11″	.005″ to .09″	.005″ to .01″	.005″ to .12″	.005″ to .100″
Net Weight. lbs. R. F.	940	975	1700		2000	
Net Weight. lbs. S. F.		975	1760	2080	2000	2400
Floor Space.	36″ x 36″	57″ x 42″	76″ x 59″	76″ x 51″	86″ x 59″	87″ x 55″
Price.						

DIMENSIONS OF PLAIN MILLING MACHINES.

No. of Machine.	3	4	5	12	13	13B	24
No. Taper Hole in Spindle.	11	11	12	10	10	10	11
Distance from Centre of Spindle to O. H. Arm.	6 3-8"	7 1-4"	8 3-8"	3 3-16"	2 7-8"	3 11-16	7 1-4"
Greatest Distance from end of spindle to Centre in Arbor Support.	22"	21"	28"	9 3-4"	11"	12 1-2"	26 1-2"
Back Geared.	Yes	Yes	Yes				
Working Surface of Table.	42" x 12"	48" x 14"	54" x 16"	29" x 6"	27" x 8"	34" x 8 1-2"	72" x 17 1-4"
Transverse Movement of Table or Spindle.	8"	8 3-4"	9 3-4"	5-8"	3"	2"	12"
Greatest Distance from Centre of Spindle to top of Table.	19 3-4"	20"	19 1-2"	7 1-2"	9 3-8"	9"	19"
Length of Automatic Feed.	34"	42"	48"	26"	15"	30"	72"
No. of Changes of Feed.	12	12	20	4	4	4	20
Variations in Feed to one rev. of Spindle	.006" to .198"	.008" to .280"	.007" to .350"	.012" to .059"	.015" to .066"	.012" to .062"	.006" to .300"
Net Weight. lbs.	3690	4340	7000	1780	2550	2315	5925
Floor Space.	84" x 75"	102" x 81"	115" x 98"	63" x 46"	49" x 47"	72" x 51 1-2"	59" x 153"
Price.							

No. 00

7 in. and 4 1-4 in. x 4 1-4 in. x 7 1-2 in.

HAND MILLING MACHINE.

The table has a longitudinal movement of 7″, a transverse movement of 4 1-4″ and can be lowered 7 1-2″ from centre of spindle.

No. 00

7 in. and 4 1-4 in. x 4 1-4 in. x 7 1-2 in.

HAND MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end has a No. 9 taper hole.

The Cone has 4 steps, the largest 9″ diameter for 2″ belt.

The Overhanging Arm can be removed or turned out of the way. Distance from centre of spindle to arm, 5 1-8″; greatest distance from end of spindle to centre in arm, 10 1-2″.

The Table, including oil pans and channels, is 20″ long, 7 1-2″ wide, has a working surface 16″x 5 1-4″, 1 T slot 5-8″ wide, a transverse movement of 4 1-4″ and can be lowered 7 1-2″ from centre of spindle.

The Feed of table, of 4 1-4″, is obtained by the extreme throw of the lever at any setting. The table rack allows a longitudinal movement of 7″.

An Adjustable Dial, graduated to read to thousandths of an inch, indicates the transverse movement of the table.

The Vertical Movement, of 7 1-2″, is operated by a lever on the front of the knee. An adjustable stop is provided. The knee saddle and table are counter-balanced by weights inside of the column.

The Vise is flanged and has hardened jaws 4 1-8″ wide, 1 1-16″ deep and will open 2″.

The Counter-shaft has 1 tight and 2 loose pulleys 10″ in diameter for 2 1-2″ belts and should run about 250 revolutions per minute.

Weight of machine ready for shipment, about 1300 lbs.

Net Weight, about 940 lbs.

Floor Space, 36″x 36″.

Dimensions of box in which machine is shipped, about 41″x 29″x 61″.

Price includes No. 1 Flanged Vise, "C" collet, oil can, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

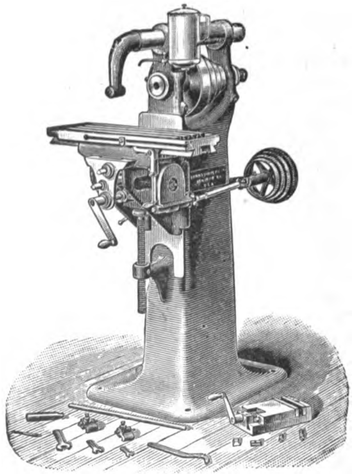
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 0

16 in. x 4 1-4 in. x 14 1-2 in.

PLAIN MILLING MACHINE.

Screw Feed Machine Patented
May 23, 1893; Aug. 29, 1899; Jan. 13, 1903.



Cut Shows Rack Feed Machine.

The table has an automatic longitudinal feed of 16″, a transverse movement of 4 1-4″, and can be lowered 14 1-2″ from centre of spindle.

No. 0

16 in. x 4 1-4 in. x 14 1-2 in.

PLAIN MILLING MACHINE.

With Rack or Screw Feed.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end has a No. 9 taper hole.

The Cone has 4 steps for 2 1-4" belt, giving 4 changes of speed direct and 4 reverse from 90 to 360 revolutions per minute.

The Overhanging Arm can be removed or turned out of the way. Distance from centre of spindle to arm, 5 1-8"; greatest distance from end of spindle to centre in arm, 10 1-2".

The Table, including oil pans and channels, is 25" long, 27" for Screw Feed Machine, 8" wide, has a working surface 26" x 8", 3 T slots 1-2" wide, a transverse movement of 4 1-4" and can be lowered 14 1-2" from centre of spindle.

The Feed of table, of 16", is automatic in either direction and can be automatically released at any point. There are 8 changes of feed varying from .005" to .11" to one revolution of spindle.

Adjustable Dials graduated to read to thousandths of an inch indicate the transverse and vertical movements of table. Machine with Screw Feed has dials, graduated to read to thousandths of an inch, for longitudinal feed.

The Vise, with Rack Feed Machine, is flanged and has hardened jaws 4 1-8" wide, 1 1-16" deep and will open 2".

The Vise, with Screw Feed Machine, swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 1 tight and 2 loose pulleys 12" in diameter for 2 1-2" belt, and should run about 180 revolutions per minute in either direction.

Weight of machine ready for shipment: Rack Feed, about 1260 lbs.; Screw Feed, about 1375 lbs.

Net Weight, about 970 lbs.

Floor Space, 57"x 42".

Dimensions of boxes in which machines are shipped, Rack Feed, 40"x 38"x 61"; Screw Feed, 39"x 38"x 61".

Price includes vise, No. 1 Flanged for Rack Feed, or No. 2 Flanged for Screw Feed, oil can, "C" collet, wrenches and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, with Rack Feed, $

Price, with Screw Feed, $

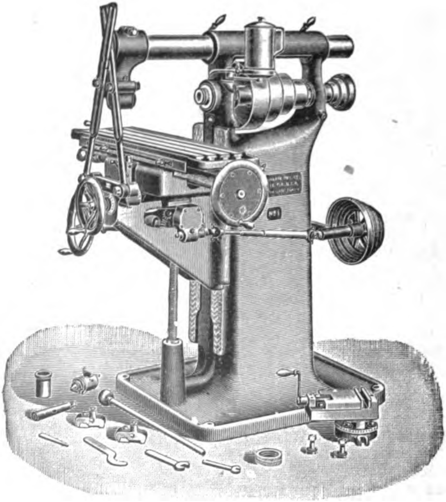
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 1

24 in. x 6 1-2 in. x 18 1-2 in.

PLAIN MILLING MACHINE.

Screw Feed Machine Patented
May 23, 1893: Aug. 29, 1899; Jan. 1, 1903.



Cut Shows Screw Feed Machine.

The table has an automatic longitudinal feed of 24″, a transverse movement of 6 1-2″, and can be lowered 18 1-2″ from centre of spindle.

No. 1

24 in. x 6 1-2 in. x 18 1-2 in.

PLAIN MILLING MACHINE.

With Rack or Screw Feed.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt, giving, with 2 speeds of counter, 4 changes of speed direct and 4 reverse, from 65 to 292 revolutions per minute; or 8 direct, from 56 to 333 revolutions per minute.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16". The arbor support has a hole for bearing for outer end of arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position milling can be done to 13" from face of column.

The Table, including oil pans and channels, is 38" long, 10" wide, and has a working surface 32" x 10", 3 T slots 5-8" wide, a transverse movement of 6 1-2" and can be lowered 18 1-2" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 24", is automatic in either direction and can be automatically released at any point. There are 8 changes of feed, varying, on the Rack Feed Machine, from .007" to .12" and on the Screw Feed Machine from .005" to .09" to one revolution of spindle.

Adjustable Dials, graduated to read to thousandths of an inch, indicate the transverse and vertical movements of table. Machine with Screw Feed has a dial, graduated to read to thousandths of an inch, for longitudinal feed.

The Vise, with Rack Feed Machine, is flanged and has hardened jaws 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Vise, with Screw Feed Machine, swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep, and will open 2 3-4".

The Counter-shaft has 2 tight and 2 loose pulleys 14" in diameter for 3 1-2" belt and should run about 105 revolutions per minute in either direction.

Weight of machine ready for shipment: Rack Feed, about 2200 lbs.; Screw Feed, about 2320 lbs.

Net Weight, Rack Feed, about 1700 lbs.; Screw Feed, about 1790 lbs.

Floor Space, 76" x 59".

Dimensions of box in which machine is shipped, 50" x 34" x 63".

Price includes vise, No. 2 Flanged for Rack Feed, or No. 2 Swivel for Screw Feed, oil can, "E" collet, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, with Rack Feed, $

Price, with Screw Feed, $

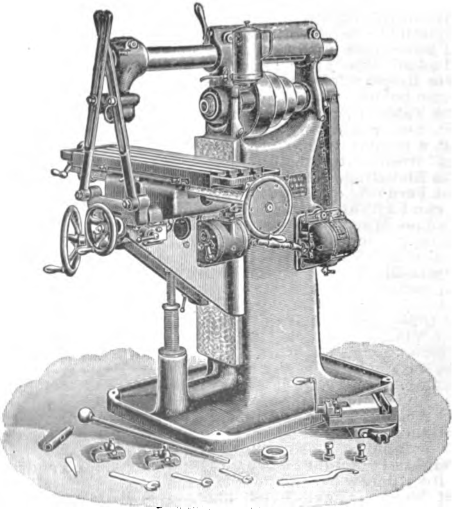
For Arbors, Collets, Tapers, Attachments and List of **Tools, see pages** 46 to 89.

No. 1-B

24 in. x 7 1-2 in. x 18 in.

PLAIN MILLING MACHINE.

Patented May 23, 1893; Aug. 29, 1899; Sept. 10, 1901; Jan. 13, 1903; Others pending.



The table has an automatic longitudinal feed of 24″, an automatic transverse movement of 7 1-2″ and can be lowered 18″ from centre of spindle.

No. 1-B
24 in. x 7 1-2 in. x 18 in.
PLAIN MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt, giving with 3 speeds of counter, 8 changes of speed direct from 56 to 333 revolutions per minute and 4 reverse from 65 to 292 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16 1-2". The arbor support has a hole for bearing for outer end of arbor etc., as well as an adjustable centre. It is clamped at both bearings by one lever at the front of machine.

Arm Braces are furnished and with these in position milling can be done to 16" from face of column.

The Table, including oil pans and channels, is 39 1-2" long, 10" wide, has a working surface 32" x 10", 3 T slots 5-8" wide, a transverse movement of 7 1-2" and can be lowered 18" from centre of spindle.

The Elevating Screw is telescopic and does not pass below the base of the machine.

The Feed of table, of 24", is positive and automatic in either direction. It can be changed by a simple movement of a lever on the front of the saddle. It is driven by a chain and sprocket wheels. There are 12 changes of feed obtained by means of change gears varying from .005" to .100" to one revolution of spindle.

Adjustable Dials, graduated to read to thousandths of an inch, indicate the longitudinal, transverse and vertical movements of table.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belts and should run about 90 and 120 revolutions per minute direct and 105 reverse.

Weight of machine ready for shipment, about 2675 lbs.

Net Weight, about 2080 lbs.

Floor space, 76" x 51".

Dimensions of box in which machine is shipped, 53" x 34" x 67".

Price includes No. 2 Swivel Vise, oil can, "E" collet, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

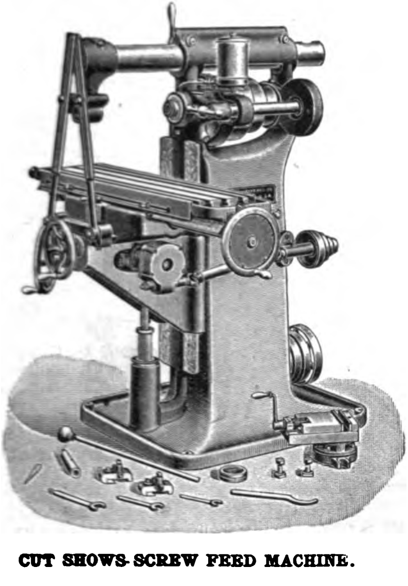
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 2

28 in. x 6 1-2 in. x 18 1-2 in.

PLAIN MILLING MACHINE.

Screw Feed Machine Patented
May 23, 1893; Aug. 29, 1899; Jan. 13, 1903.



CUT SHOWS SCREW FEED MACHINE.

The table has an automatic longitudinal feed of 28″, a transverse movement of 6 1-2″, and can be lowered 18 1-2″ from centre of spindle.

No. 2

28 in. x 6 1-2 in. x 18 1-2 in.

PLAIN MILLING MACHINE.

With Rack or Screw Feed.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt and is back geared giving, with 2 speeds of counter, 8 changes of speed direct and 8 reverse, from 17 to 290 revolutions per minute; or 16 direct, from 16 to 318 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor, etc., as well as an adjustable centre.

Arm Braces are furnished, and with these in position, milling can be done to 13 1-2" from face of column.

The Table, including oil pans and channels, is 40" long, 10 1-4" wide, has a working surface 34" x 10", 3 T slots 5-8" wide, a transverse movement of 6 1-2" and can be lowered 18 1-2" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 28", is automatic in either direction and can be automatically released at any point. There are 12 changes of feed varying, on the Rack Feed Machine from .006" to .13", and on the Screw Feed Machine from .005" to .12" to one revolution of spindle.

Adjustable Dials, graduated to read to thousandths of an inch, indicate the transverse and vertical movements of table. Machine with Screw Feed has dials, graduated to read to thousandths of an inch, for longitudinal feed.

The Vise, with Rack Feed Machine, is flanged and has hardened jaws 6 1-8" wide, 1 9-16" deep, and will open 3 5-8".

The Vise, with Screw Feed Machine, swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep, and will open 2 3-4".

The Counter-shaft has 2 tight and 2 loose pulleys 14" in diameter for 3 1-2" belts and should run about 160 revolutions per minute in either direction.

Weight of machine ready for shipment: about 2700 lbs.

Net Weight, about 2175 lbs.

Floor Space, Rack Feed Machine, 68"x 57"; Screw Feed Machine, 86"x 59".

Dimensions of box in which machine is shipped, 50"x 34" x 63".

Price includes vise, No. 3 Flanged for Rack Feed or No. 2 Swivel for Screw Feed, oil can, "E" collet, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, Rack Feed, $ **Price, Screw Feed, $**

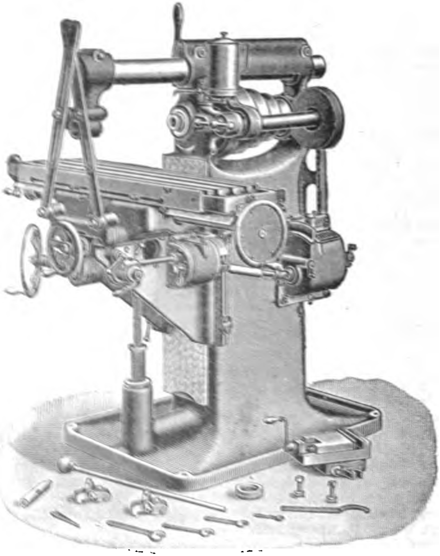
For Arbors, Collets, Tapers, Attachments and List of **Tools, see pages** 46 to 89.

No. 2-B

28 in. x 7 1-2 in. x 18 in.

PLAIN MILLING MACHINE.

Patented May 23, 1898; Aug. 29, 1899; Sept. 10, 1901; Jan. 13, 1903; Others pending.



The table has an automatic longitudinal feed of 28", an automatic transverse movement of 7 1-2" and an automatic vertical feed of 18".

No. 2-B

28 in. x 7 1-2 in. x 18 in.

PLAIN MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 10 taper hole.

The Cone has 4 steps for 3" belt and is back geared, giving with 3 speeds of counter, 16 changes of speed direct from 16 to 318 revolutions per minute and 8 reverse from 17 to 290 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 5 1-2"; greatest distance from end of spindle to centre in arbor support, 16 1-2". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished and with these in position, milling can be done to 16" from face of column.

The Table, including oil pans and channels, is 40" long, 10" wide, has a working surface 34"x 10", 3 T slots, 5-8" wide, an automatic transverse movement of 7 1-2" and can be lowered 18" from centre of spindle.

The Elevating Screw is telescopic and does not pass below the base of the machine.

The Feed of table, of 28", is positive and automatic in either direction, screw driven and can be changed by a simple movement of lever on front of saddle. It is driven by a chain and sprocket wheel. There are 20 changes of feed obtained by means of change gears varying from .003" to .120" to one revolution of spindle.

Adjustable Dials graduated to read to thousandths of an inch indicate the longitudinal, transverse and vertical movements of table.

The Vise swivels and has a graduated base. The jaws are hardened, 5 1-8" wide, 1 1-4" deep and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belts and should run about 144 and 175 revolutions per minute direct, and 160 reverse.

Weight of machine ready for shipment, about 3000 lbs.

Net Weight, about 2435 lbs.

Floor Space, 87"x 55".

Dimensions of box for shipment, 50"x 34"x 63".

Price includes No. 2 Swivel Vise, "E" collet, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

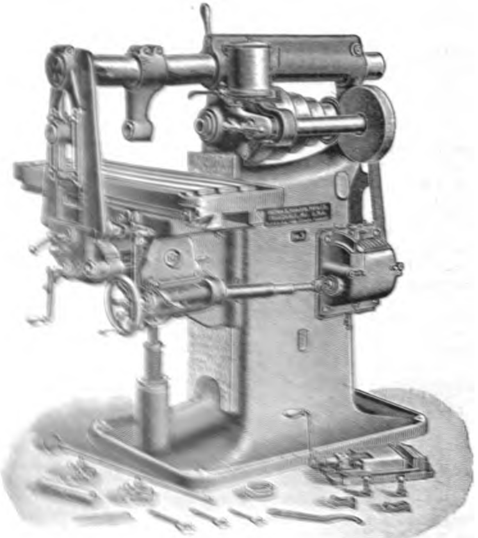
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 3

34 in. x 9 in. x 19 3-4 in.

PLAIN MILLING MACHINE.

Screw Feed Machine Patented Feb. 6, 1900.
Rack Feed Machine Patented Jan. 18, 1898; Feb. 6, 1900.
Others pending.



[illegible] Rack Feed Machine.

[illegible] longitudinal feed [illegible] and can be [illegible] spindle.

No. 3

34 in. x 9 in. x 19 3-4 in.

PLAIN MILLING MACHINE.

With Rack or Screw Feed.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a No. 11 taper hole.

The Cone has 4 steps for 3 1-2" belt and is back geared, giving, with 2 speeds of counter, 16 changes of speed, from 13 to 392 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 6 3-8"; greatest distance from end of spindle to centre in arbor support, 22". It is clamped at both bearings by one lever. The arbor support has a hole for bearing for arbor etc., as well as an adjustable centre.

Arm Braces are furnished, and with these in position, milling can be done to 20" from face of column.

The Table, including oil pans and channels, is 50" long, 14 1-4" wide, has a working surface 42" x 12", 3 T slots 5-8" wide, a transverse movement of 9", and can be lowered 19 3-4" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 34", is automatic in either direction and can be automatically released at any point. It is driven direct from the spindle by a chain and sprocket wheels. There are 20 changes of feed, obtained by means of change gears, varying from .005" to .200" to one revolution of spindle. A fine hand feed is also provided. When the feed is automatically released, the table remains locked in position.

Adjustable Dials graduated to read to thousandths of an inch indicate the transverse and vertical movements of table.

The Vise is flanged and has hardened jaws 6 1-8" wide, 1 9-16" deep, and will open 3 5-8".

The Counter-shaft has 2 tight and 2 loose pulleys, 14" and 18" in diameter for 4" belts, and should run about 198 and 158 revolutions per minute.

Weight of machine ready for shipment about 4420 lbs.

Net Weight, about 3625 lbs.

Floor Space, 84" x 63".

Dimensions of box in which machine is shipped, 65" x 44" x 71".

Price includes No. 3 Flanged Vise, oil can, "G" collet, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, Rack or Screw Feed, $ **With Pump, $**

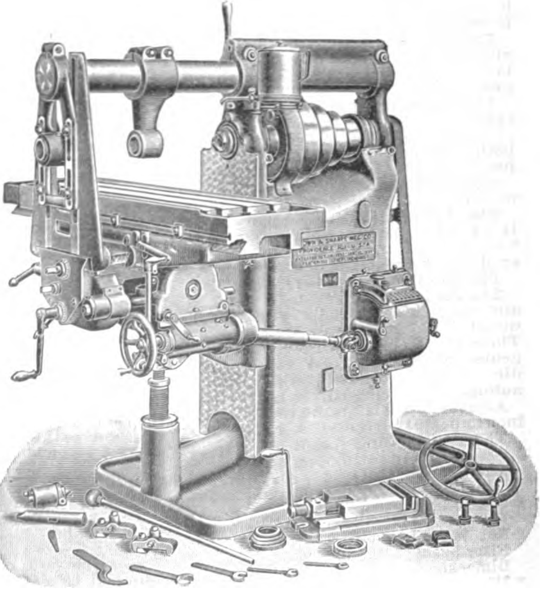
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 4

42 in. x 8 3-4 in. x 20 in.

PLAIN MILLING MACHINE.

Patented Oct. 18, 1892; Jan. 18, 1898; Feb. 6, 1900.
Others pending.



The table has an automatic longitudinal feed of 42″, an automatic transverse movement of 8 3-4″ and can be lowered 20″ from centre of spindle.

No. 4 42 in. x 8 3-4 in. x 20 in.
PLAIN MILLING MACHINE.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded, has a No. 11 taper hole, a recess across the end and a cap nut by which an arbor or collet provided with a clutch collar can be positively locked.

The Cone has 4 steps for 3 1-2". belt and is back geared, giving, with 2 speeds of counter, 12 changes of speed, from 10 to 487 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 7 1 4"; greatest distance from end of spindle to centre in arbor support, 21". It is clamped at both bearings by one lever. An arm support is furnished that has a bearing for the arbor, thus allowing the usual arbor support to be used at any intermediate point near the cutter and with the support in position, milling can be done to 22 1-2" from face of column.

The Table, including oil pans and channels, is 60" long, 15 7-8" wide, has a working surface 48" x 14", 3 T slots 3-4" wide, an automatic transverse feed of 8 3-4" and can be lowered 20" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 42", is automatic in either direction and can be automatically released at any point. It is driven by a chain and sprocket wheels. There are 20 changes of feed, obtained by means of change gears, varying from .006" to .300" to one revolution of spindle. A fine hand feed is also provided. When the feed is automatically released the table remains locked in position.

Adjustable Dials, graduated to read to thousandths of an inch, indicate the longitudinal, transverse and vertical movements of table.

The Vise is flanged and has hardened jaws 7 1-8" wide, 2" deep and will open 4 1-2".

The Counter-shaft has 2 tight and 2 loose pulleys 14" and 18" in diameter for 4" belts and should run about 225 and 175 revolutions per minute.

Weight of machine ready for shipment: Hand Vertical Feed, without pump, about 5350 lbs.; with pump, about 5415 lbs.; Power Vertical Feed, without pump, about 6100 lbs.; with pump, about 6165 lbs. Tools, about 125 lbs.

Net Weight: Hand Vertical Feed, without pump, about 4465 lbs.; with pump, about 4530 lbs.; Power Vertical Feed, without pump, about 5200 lbs.; with pump, about 5265 lbs. Tools, about 100 lbs.

Dimensions of boxes for shipment: Hand Vertical Feed, 72"x 52"x 75"; Power Vertical Feed, 67"x 51"x 73".

Price includes No. 4 Flanged Vise, oil can, "G" collet, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. **Price, $** Price, with Pump, $

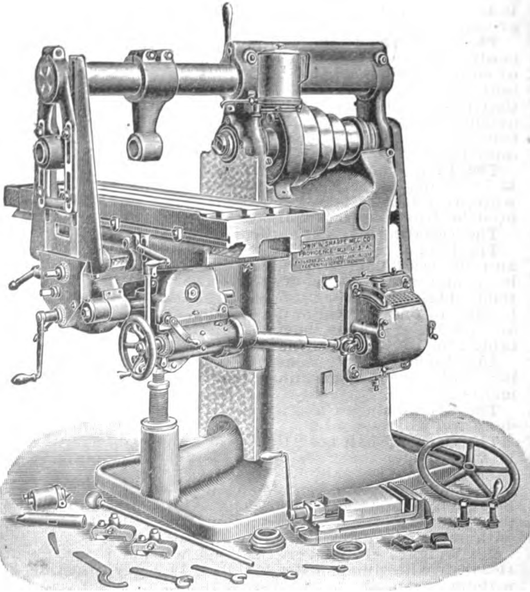
For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 89.

No. 5

48 in. x 9 3-4 in. x 19 1-2 in.

PLAIN MILLING MACHINE.

Patented Oct. 18, 1892; Jan. 18, 1898; Feb. 6, 1900.
Others pending.



The table has an automatic longitudinal feed of 48″, an automatic transverse movement of 9 3-4″ and the table can be lowered 19 1-2″ from centre of spindle.

No. 5

48 in. x 9 3-4 in. x 19 1-2 in.

PLAIN MILLING MACHINE.

With Hand or Power Vertical Feed.

The Spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded, has a No. 12 taper hole, a recess across the end and a cap nut by which an arbor or collet provided with a clutch collar can be positively locked.

The Cone has 3 steps for 4 1-2" belt and is double back geared, giving, with 2 speeds of counter, 18 changes of speed, varying from 10 to 404 revolutions per minute. Speeds in geometrical progression.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 8 3-8"; greatest distance from end of spindle to centre in arbor support, 28". It is clamped at both bearings by one lever. An arm support is furnished that has a bearing for the arbor, thus allowing the usual arbor support to be used at any intermediate point near the cutter, and, with the support in position, milling can be done to 27" from face of column.

The Table, including oil pans and channels, is 66 1-4" long, 18" wide, has a working surface 54"x 16", 3 T slots 3-4" wide, an automatic transverse feed of 9 3-4" and can be lowered 19 1-2" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 48", is automatic in either direction and can be automatically released at any point. It is driven by a chain and sprocket wheels. There are 20 changes of feed, varying from .007" to .350" to one revolution of spindle. A fine hand feed is also provided. When the feed is automatically released, the table remains locked in position.

Adjustable Dials, graduated to read to thousandths of an inch, indicate the movements of table.

The Vise is flanged and has hardened jaws 7 1-8" wide, 2" deep and will open 4 1-2".

The Counter-shaft has 2 tight and loose pulleys, 16" and 20" in diameter for 5" belts and should run about 325 and 170 revolutions per minute.

Weight of machine ready for shipment: Hand Vertical Feed, without pump, about 8145 lbs., with pump, about 8225 lbs.; Power Vertical Feed, without pump, about 8255 lbs., with pump, about 8345 lbs.; tools, about 250 lbs.

Net Weight: Hand Vertical Feed, without pump, about 6960 lbs., with pump, about 7245 lbs.; Power Vertical Feed, without pump, about 7040 lbs., with pump, about 7235 lbs.; tools, about 200 lbs. **Floor Space,** 115"x 72".

Dimensions of box for shipment, 77"x 58"x 77".

Price includes No. 4 Flanged Vise, oil can, "T" collet, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. **Price, $ With Pump, $**

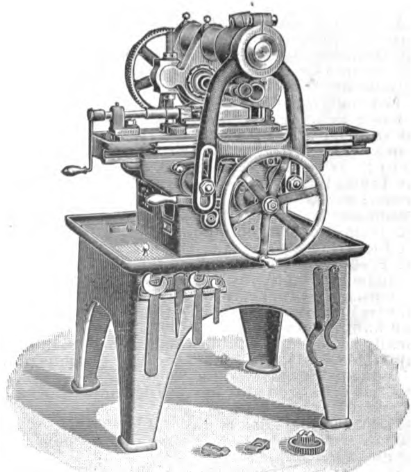
Price, with Power Vertical Feed, $ With Pump, $

For Arbors, Collets, Tapers, Attachments and List of Tools, see pages 46 to 87.

No. 12

26 in. x 5-8 in. x 7 1-2 in.

PLAIN MILLING MACHINE.



The table has an automatic longitudinal feed of 26″, the spindle has a transverse adjustment of 5-8″ and the greatest distance from centre of spindle to top of table is 7 1-2″.

No. 12

26 in. x 5-8 in. x 7 1-2 in.

PLAIN MILLING MACHINE.

The Spindle runs in bronze boxes provided with means of compensation for wear. It is driven from cone by gear and pinion, has a vertical adjustment by means of nuts placed on a vertical screw and a transverse adjustment of 5-8". The front end has a No. 10 taper hole.

The Cone has 3 steps for 2 1-2" belt.

The Overhanging Arm has an adjustable centre support and brace. Distance from centre of spindle to arm, 3 11-16"; greatest distance from end of spindle to centre in arm, with arm brace in position, 8 1-4"; without arm brace, 10 1-4".

The Table, including oil pans and channels, is 37" long and 10" wide, has a working surface 29"x 6", and a T slot 5-8" wide. Greatest distance from centre of spindle to top of table, 7 1-2"; least, 2 1-2".

The Feed of table, of 26", is automatic in either direction and can be automatically released at any point. It is driven by a chain and sprocket wheels. There are 4 changes of feed, obtained by means of change gears, varying from .012" to .059" to one revolution of spindle.

An Oil Tank forms part of the base of the machine and provides for the use of a pump.

The Vise is flanged, has hardened jaws 6 1-8" wide, 1 9-16" deep and will open 3 5-8".

The Counter-shaft has tight and loose pulleys 10" in diameter for 3" belt and should run about 280 revolutions per minute.

Weight of machine ready for shipment, about 2210 lbs.

Net Weight, about 1780 lbs.

Floor Space, 63" x 46".

Dimensions of box in which machine is shipped, 44"x 40" x 59".

Price includes No. 3 Flanged Vise, oil can, wrenches, and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, Pipes, etc., furnished when desired.

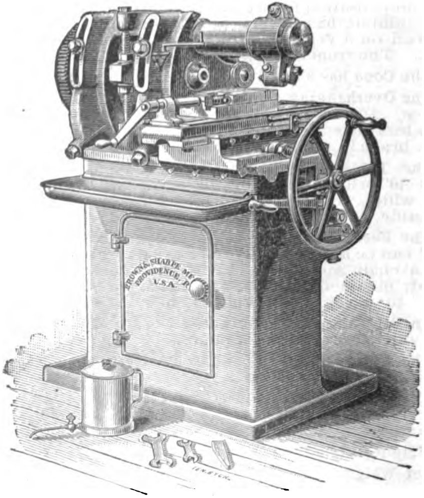
Price, $

For Arbors, Collets and Tapers, see pages 46 to 53; Index Centres, pages 77 to 86; Vises, pages 87 to 89.

No. 13

15 in. x 3 in. x 9 3-8 in.

PLAIN MILLING MACHINES.



The table has an automatic longitudinal feed of 15″, a transverse movement of 3″, and the greatest distance from centre of spindle to top of table is 9 3-8″. It is also made with Compound F[illegible] Gears.

No. 13
15 in. x 3 in. x 9 3-8 in.
PLAIN MILLING MACHINES.

The Spindle runs in bronze boxes provided with means of compensation for wear. It is driven from cone by gear and pinion and has a vertical adjustment by means of nuts placed on a vertical screw. The front end has a No. 10 taper hole.

The Cone has 3 steps for 3" belt.

The Overhanging Arm has an adjustable centre support and an arm brace. Distance from centre of spindle to arm, 2 7-8"; greatest distance from end of spindle to centre in arm, 11".

The Table, including oil pans and channels, is 31 1-2" long and 10 1-2" wide, has a working surface 27"x 8", 3 T slots 5-8" wide and a transverse movement of 3". Greatest distance from centre of spindle to top of table, 9 3-8"; least, 3 5-8".

The Feed of table, of 15", is automatic and can be automatically released at any point. It is a screw feed and can be quickly returned by hand. There are 4 changes of feed, varying from .015" to .066" to one revolution of spindle.

In addition to the oil pans and channels surrounding the table, an oil tank is attached to each machine providing for the use of a pump.

The Vise is flanged, has hardened jaws 6 1-8" wide, 1 9-16" deep, and will open 3 5-8".

The Counter-shaft has tight and loose pulleys 10" in diameter for 3 1-4" belt and should run about 275 revolutions per minute.

Weight of machine ready for shipment, about 2960 lbs.

Net Weight, about 2450 lbs. **Floor Space**, 49"x 47".

Dimensions of box in which machine is shipped, 48"x 39"x 64".

Price includes No. 3 Flanged Vise, oil can, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, Pipes, etc., furnished when desired.

Price, $

This machine is also furnished with **COMPOUND BACK GEARS**; when so fitted:

The Spindle has a hole its entire length and a recess across the front end. The outer support has a bearing for arbor.

The Counter-shaft has tight and loose pulleys 15" and 18" in diameter for 3 1-2" belts and should run about 275 and 333 revolutions per minute.

Weight of machine ready for shipment, about 3210 lbs.

Net Weight, about 2600 lbs. **Floor Space**, 49" x 47".

Dimensions of box in which machine is shipped, 48" x 39" x 64".

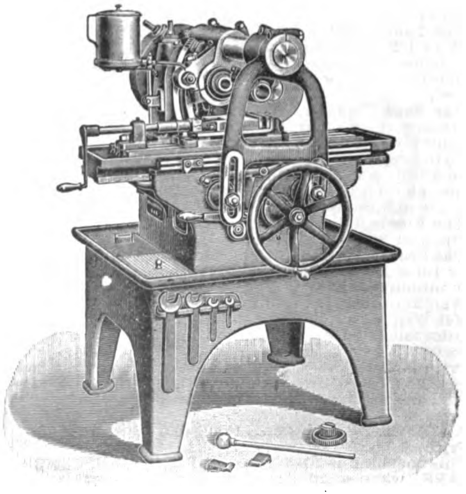
Price, $ **Price, with pump, $**

For Arbors, Collets and Tapers, see pages 46 to 52; Centres, pages 77 to 86; Vises, pages 87 to 89.

No. 13-B

30 in. x 2 in. x 9 in.

PLAIN MILLING MACHINE.



The table has an automatic longitudinal feed of 30″; the spindle has a transverse adjustment of 2″ and the greatest distance from centre of spindle to top of table is 9″.

No. 13-B

30 in. x 2 in. x 9 in.

PLAIN MILLING MACHINE.

The Spindle runs in bronze boxes provided with means of compensation for wear. It is driven from cone by gear and pinion, has a vertical adjustment of 6" and a transverse adjustment of 2". The front end has a No. 10 taper hole.

The Cone has 3 steps, the largest 12 1-4" in diameter, for 2 3-4" belt.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 3 11-16"; greatest distance from end of spindle to centre in arbor support with arm brace in position, 10 1-2"; without arm brace, 12 1-2". The arbor support has a bronze bushing for bearing of arbor, also an adjustable centre.

The Table, including oil pans and channels, is 42" long and 12" wide, has a working surface, 34" x 8 1-2" and 3 T-slots 5-8" wide. Greatest distance from centre of spindle to top of table, 9", least, 3".

The Feed of table, of 30", is automatic in either direction. An automatic stop is provided which releases the feed at any desired point. The feed is driven by a chain and sprocket wheels through a worm and worm wheel to a rack on under side of table, thus combining the advantages of a rack and screw feed machine and securing a powerful, direct and steady feed. There are 4 changes of feed obtained by means of change gears, varying from .012" to .062" to one revolution of the spindle.

The Bed of the machine is supported on a stand that is amply heavy to insure rigidity. The top of the stand is large and provided with an oil rim to catch all waste oil and protect the floor. A large tank forms part of the casting of the stand and provides for the use of a pump.

The Vise is flanged and has jaws 6 1-8" wide, 1 9-16" deep, and will open 3 5-8".

The Counter-shaft has tight and loose pulleys 10" in diameter for 3 1-2" belt and should run about 330 revolutions per minute.

Weight of machine ready for shipment, about 2800 lbs.

Net Weight, about 2300 lbs.

Dimensions of box in which machine is shipped, 48" x 39" x 64". **Floor Space**, 72" x 51".

Price includes No. 3 Flanged Vise, oil can, wrenches, Treatise on Milling Machines, and everything shown in cut, together with overhead works, boxed and delivered **f. o. b.** at Providence, R. I.

Price, $

Pumps, pipes and fittings furnished when desired.

Price, $

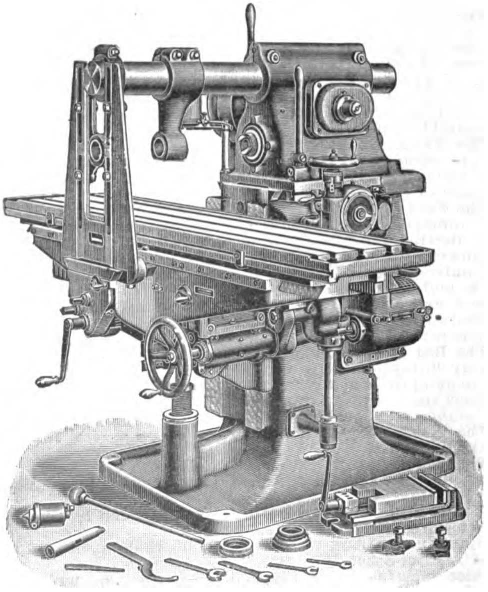
For Arbors, Collets and Tapers, see pages 46 to 53; **Index Centres**, pages 77 to 86; **Vises**, pages 87 to 89.

No. 24

72 in. x 12 in. x 19 in.

PLAIN MILLING MACHINE.

Patented October 18, 1892; January 18, 1898; February 6, 1900.



The table has an automatic longitudinal feed of 72″, and an automatic vertical feed of 19″. The head has an automatic transverse movement of 12″.

No. 24
72 in. x 12 in. x 19 in.
PLAIN MILLING MACHINE.
Power Feeds in all Directions.

The Spindle is hollow, runs in bronze boxes provided with means of compensation for wear and is driven by worm and worm gear. The worm is of steel hardened and the worm gear of bronze. The worm wheel runs in oil. The front end of spindle is threaded, has a No. 11 taper hole, a recess across the end and a cap nut by which an arbor or collet provided with a clutch collar can be positively locked.

The Cone has 2 steps for 3 1-2" belt and with two speeds of counter, gives 8 changes of speed, from 17 to 112 revolutions per minute. Speeds in geometrical progression.

The Head has an automatic transverse movement of 12" in either direction.

The Overhanging Arm is a solid steel bar. Distance from centre of spindle to arm, 7 1-4"; greatest distance from end of spindle to centre in arbor support, 26 1-2". It is clamped at both bearings by one lever. An arm support is furnished and with this in position milling can be done to 22 1-2" from face of column.

The Table, including oil pans and channels, is 81" long and 17 1-4" wide, has a working surface 72"x 17 1-4", 3 T slots 3-4" wide and can be lowered 19" from centre of spindle.

The Elevating Screw is telescopic.

The Feed of table, of 72", is automatic in either direction and can be automatically released at any point. It is driven by a chain and sprocket wheels direct from the spindle. There are 20 changes of feed, varying from .006" to .300" to one revolution of spindle. A fine hand feed is also provided. When the feed is automatically released, the table remains locked in position.

Adjustable Dials graduated to read to thousandths of an inch indicate the longitudinal, transverse and vertical movements. A dial, graduated to read to 64ths of an inch, indicates the transverse movement of the head.

The Vise is flanged and has hardened jaws 7 1-8" wide, 2" deep, and will open 4 1-2".

The Counter-shaft has 2 tight and loose pulleys 14" and 18" in diameter for 3 1-2" and 4" belts and should run about 350 and 267 revolutions per minute.

Weight of machine ready for shipment, about 7195 lbs.; tools, about 125 lbs.

Net Weight, about 5925 lbs.; tools about 100 lbs.

Floor Space, 59"x 153".

Dimensions of boxes in which machine is shipped, 63"x 63"x 71", and 88"x 23"x 10".

Price includes No. 4 Flanged Vise, oil can, "G" collet, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

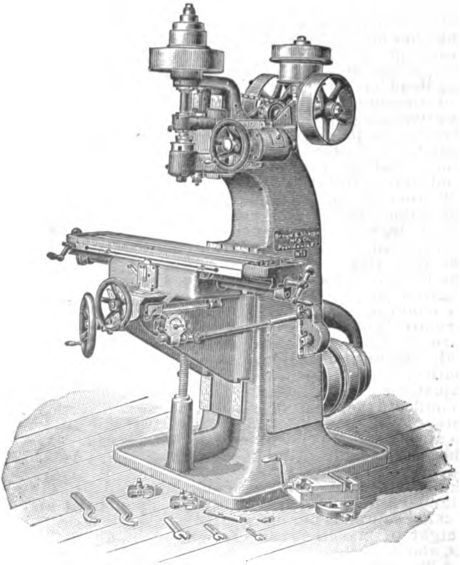
Price, $ **Price**, with Pump, **$**

For Arbors, Collets, Tapers, Attachments and Tools, see pages 46 to 89.

No. 2

26 in. x 12 in. x 20 in.

VERTICAL SPINDLE MILLING MACHINE.



This machine has an automatic longitudinal feed of 26″, and an automatic transverse feed of 12″. Greatest distance from end of spindle to top of table, 20″.

No. 2
26 in. x 12 in. x 20 in.
VERTICAL SPINDLE MILLING MACHINE.

This machine, for many kinds of work, is preferable to a machine with a horizontal spindle. The operator can more easily see the work and more readily follow any irregularity in the outline of the surface to be milled.

The Spindle runs in bronze boxes provided with means of compensation for wear and, with two speeds of counter, has 18 changes of speed, as follows: using main cone 6 direct, varying from 85 to 504; 3 reverse, from 102 to 432, and, using high speed cone 6 direct, varying from 212 to 1260 revolutions per minute; 3 reverse, from 256 to 1080. The lower end of spindle has a No. 10 taper hole.

The Cone has 3 steps for 3" belt.

The Spindle Head has a vertical movement of 4". It is operated by a hand wheel that can be used for a fine hand feed or a quick movement of the head.

A Stop, with micrometer adjustment, is also provided for controlling the depth of cut.

Distance from centre of spindle to column, 16".

The Table, including oil pans and channels, is 45" long, 10 1-4" wide, has a working surface 37 1-2" x 10 1-4", 3 T slots 5-8" wide, an automatic transverse movement of 12" and a vertical adjustment of 16". Greatest distance from end of spindle to top of table, 20".

The Feeds of table are automatic in either direction and can be reversed by the simple movement of a lever on the front of the machine. The longitudinal feed is 28", and the transverse feed is 12"; both are automatic in either direction, and can be automatically released at any point. There are 12 changes of feed for each direction, obtained by the movement of a lever controlling the feed gears, evenly graded from .005" to .125" to one revolution of spindle, with slow speed; and from .002" to .050", with fast speed. An index shows plainly the feed obtained from main cone.

The Vise swivels, and has hardened jaws 5 1-8" wide, 1 1-4" deep, and will open 2 3-4".

The Counter-shaft has 3 friction pulleys 14" in diameter for 3 1-2" belt, and should run about 120 and 360 revolutions per minute direct and 240 reverse.

Weight of machine ready for shipment, about 4035 lbs.; Circular Milling Attachment, about 250 lbs.

Net Weight, about 3050 lbs.; Circular Milling Attachment, about 200 lbs. **Floor Space**, 88" x 69".

Dimensions of box in which machine is shipped, 71" x 42" x 81".

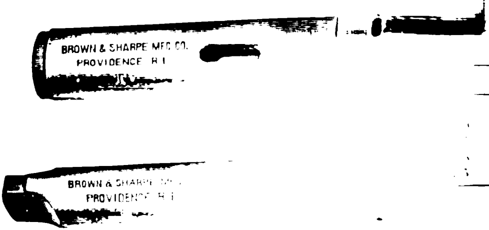
Price includes No. 2 Swivel Vise, "BB" collet, oil can and stand, wrenches, table stops, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. **Price, $**

For Circular Milling Attachment for use with this machine, see page 69.

For List of Tools for use with this machine, se

COLLETS

For Use on Milling, Grinding Machines



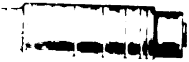
Mark.	Machine w...
†A	Nos. 1, 1 1-2, 2 & 2A Universal, Nos. 1, 1B, 2 & 2B Plain Mill. Mchs., inner collet.
*B	Nos. 0 & 00 Plain. Nos. 3 & 4 Univ., Nos. 3, 4, 5 & 24 Plain Mill. Mchs., inner collet.
‡BB	No. 2 Vertical Spdl. Mill. Mch.
*C	Nos. 0 & 00 Plain. Nos. 3 & 4 Univ., Nos. 3, 4, 5 & 24 Plain Mill. Mchs., inner collet.
*D	No. 5 Vertical Spindle Mill. Mch., inner collet.
*E	Nos. 1, 1 1-2, ... Nos. 1, 1B, 2 ... Plain Mill. ...
*EE	Nos. 1, 1 1-2, 2 ... Nos. 1, 1B, 2 ... Plain Mill ...
*F	Nos. 1, 1 1-2, 2 ... 1, 1B, 2 & 2...
‡FF	No. 2 Vertical ...
*G	Nos. 3 & 4 Univ... 24 Plain Mill...
...	No. 5 Vertical ...

... small ... taper ... The ... taper ... ver...thing

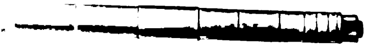
List continued ...

... marked * are prov...
... marked ‡ are prov...
... collet.
... of Tapers, ...

[illegible]CHINE CUTTER [illegible]RBORS.



A

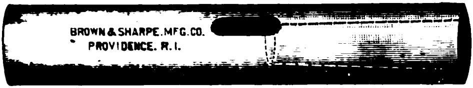


[illegible]	[illegible]	[illegible] Nut	No. of Machine where used.	No. of Taper	Price.
[illegible]	[illegible]	1"	Nos. 1, 1 1-2, 2 & 2A Un. Nos. 1, 1B, 2 & 2B Pln.	7	$3 50
[illegible]	[illegible]	4	No. 00, 0 Plain.	9	5 00
[illegible]	[illegible]	5			5 00
[illegible]	[illegible]	6			5 00
[illegible]	[illegible]	4	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 & 13B Plain.	10	5 50
[illegible]	7-8	"			5 50
[illegible]	1	"			5 50
[illegible]	1 1-16	"			5 50
[illegible]	1 1-4	"			5 50
[illegible]	7-8	5 1-4	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 & 13B Plain.	10	6 50
[illegible]	1	"			6 50
[illegible]	1 1-16	"			6 50
9	1 1-4	"			6 50
10	7-8	8	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 13 & 13B Plain.	10	7 50
11	1	"			7 50
12	1 1-16	"			7 50
13	1 1-4	"			7 50
15	7-8	10 1-4	Nos. 3 & 4 Universal; No. 3 Plain.	11	9 00
16	1	"			9 00
17	1 1-16	"			9 00
18	1 1-4	"			9 00
26	1-1-4	"	*No. 23 Plain.	11	10 50
30	7-8	"	*No. 24 Plain.	12	12 00
31	1	"			12 00
32	1 1-16	"			12 00
33	1 1-4	"			12 00

List continued on next page.

* In ordering, give construction number.

COLLET BLANKS.

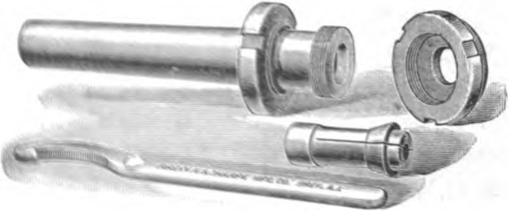


Price includes Turning Plug and Knockout Key.

Diameter.	Length over all.	No. of Taper Hole.	Price.
3-4"	5 1-4"	4	$1 50
1 1-8	8 1-2	5	2 00
1 3-8	10	7	2 50
1 5-8	12	9	3 50
2	14	10	4 50

SPRING CHUCK

For Nos. 1, 1 1-2, 2 and 2-A Universal, and Nos. 1, 1-B, 2 and 2-B Plain Milling Machines.
10 in. and 12 in. Index Centres.
10 in. Universal Index Centres.



[illegible] convenient for holding wire, small [illegible]
[illegible] ground to fit a No. 10 taper [illegible] its entire length. The [illegible] collet, which is held in [illegible] against the taper [illegible]

[illegible] and ground accu- [illegible]

[illegible] wrench and everything [illegible]

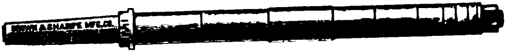
SPRING COLLETS.

[illegible]

[illegible] Price, each, $2 50
[illegible] Price, each, $4 00
[illegible] Price, each, $4 00

MILLING MACHINE CUTTER ARBORS.

B A



No. of Arbor.	Diam. Arbor.	Length from Shoulder to Nut.	No. of Machine where used.	No. of Taper	Price.
04	1-2"	1"	Nos. 1, 1 1-2, 2 & 2A Un. Nos. 1, 1B, 2 & 2B Pln.	7	$3 50
07	5-8	4	No. 00, 0 Plain.	9	5 00
08	7-8	5			5 00
09	1	6			5 00
1	5-8	4	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 & 13B Plain.	10	5 50
2	7-8	"			5 50
3	1	"			5 50
4	1 1-16	"			5 50
5	1 1-4	"			5 50
6	7-8	5 1-4	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 & 13B Plain.	10	6 50
7	1	"			6 50
8	1 1-16	"			6 50
9	1 1-4	"			6 50
10	7-8	8	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 13 & 13B Plain.	10	7 50
11	1	"			7 50
12	1 1-16	"			7 50
13	1 1-4	"			7 50
15	7-8	10 1-4	Nos. 3 & 4 Universal; No. 3 Plain.	11	9 00
16	1	"			9 00
17	1 1-16	"			9 00
18	1 1-4	"			9 00
26	1-1-4	"	*No. 23 Plain.	11	10 50
30	7-8	"	*No. 24 Plain.	12	12 00
31	1	"			12 00
32	1 1-16	"			12 00
33	1 1-4	"			12 00

List continued on next page.

* In ordering, give construction number of machine.

MILLING MACHINE CUTTER ARBORS.

(CONTINUED.)

Following Arbors have hardened sleeve, A, for outer bearing:

No. of Arbor.	Diam. Arbor.	Length from Shoulder to Nut.	No. of Machine where used.	No. of Taper.	Price.
40	7-8	12"	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 & 13B Plain.	10	$11 00
41	1	"			11 00
42	1 1-16	"			11 00
43	1 1-4	"			11 00
44	7-8"	17	Nos. 1, 1 1-2, 2 & 2A Universal; Nos. 1, 1B, 2 & 2B Plain.	10	12 00
45	1	"			12 00
46	1 1-16	"			12 00
47	1 1-4	"			12 00
48A	7-8	16 1-4	No. 3 Universal; No. 3 Plain.	11	13 00
49A	1	17 3-4			13 00
50A	1 1-16	"			13 00
51A	1 1-4	20 1-4			13 00
52A	1 1-2	"			13 00
*57	1 1-2	20 1-4	No. 23 Plain.	11	14 00
60	7-8	17	†No. 24 Plain.	12	15 00
61	1	22 1-2			15 00
62	1 1-16	"			15 00
64	1 1-2	"			15 00
*65	1	22	No. 4 Universal.	11	15 00
*66	1 1-4	26 3-4			15 00
*67	1 1-2	"			15 00
*68	1 3-4	"			15 00
*65A	1	22	Nos. 4 & †24 Plain.	11	17 00
*66A	1 1-4	26 3-4			17 00
*67A	1 1-2	"			17 00
*68A	1 3-4	"			17 00
*70	1 1-4	29	No. 5 Plain.	12	20 00
*71	1 1-2	"			20 00
*72	2	"			20 00

*These Arbors are provided with Clutch Collars, B.
†In ordering, give construction number of machine.
For sizes of Tapers, see page 51.

MILLING MACHINE SCREW ARBORS.

No. of Arbor.	Diam. Arbor.	Thread	Machine where used.	No. of Taper.	Price.
120	3-8"	20, L.	Nos. 1, 1 1-2, 2 & 2A Univ. Nos. 1, 1B, 2 & 2B Plain. No. 2 Vertical Spindle.	7	$2 00
122	1-2	16, L.	Nos. 3 & 4 Universal. Nos. 00, 0, 3, 4 & 24 Plain.	9	3 00
125	3-8	20, L.	Nos. 1, 1 1-2, 2 & 2A Univ. 1, 1B, 2, 2B, 12, 13 & 13B Pl.	10	3 50
130	1	10, L.	Nos. 3 & 4 Universal. Nos. 3, 4 & 24 Plain.	11	6 00
*133	1	10, L.	No. 4 Universal. Nos. 4 & 24 Plain.	11	7 00

*This Arbor is provided with a Clutch Collar.

STANDARD TAPERS.

For Spindles, Collets, Arbors, &c., as Referred to in this Catalogue.

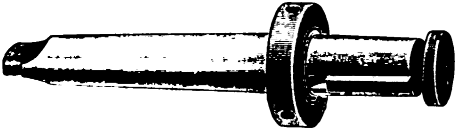
No. of Taper	1	2	3	4	5	6	7	8	9
Dia. at small end	.20"	.25"	.312"	.35"	.45"	.50"	.60"	.75"	.90"

No. of Taper	10	11	12	13	14	15	16	17	18
Dia. at small end	1.05"	1.25"	1.50"	1.75"	2"	2.25"	2.50"	2.75"	3"

Tapers per foot and Corresponding Angles.

Taper Per Ft.	Included Angle.	Angle with Centre Line	Taper Per Ft.	Included Angle.	Angle with Centre Line.
1-8"	0°—36′	0°—18′	1"	4°—46′	2°—23′
1-4"	1°—12′	0°—36′	1 1-2"	7°—09′	3°—35′
5-16"	1°—30′	0°—45′	1 3-4"	8°—20′	4°—10′
3-8"	1°—47′	0°—54′	2"	9°—31′	4°—46′
7-16"	2°—05′	1°—02′	2 1-2"	11°—54′	5°—57′
1-2"	2°—23′	1°—12′	3"	14°—15′	7°—08′
3-4"	3°—35′	1°—47′	3 1-2"	16°—36′	8°—18′
15-16"	4°—28′	2°—14′	4"	18°—55′	9°—28′

ARBORS FOR FACE MILLING CUTTERS
With Inserted Teeth.



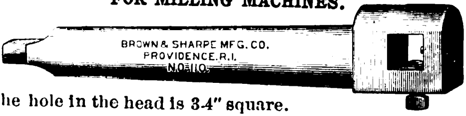
No. of Arbor.	Machine where used.	No. of Taper for Mill.	No. of Taper of Shank.	Price.
79	Nos. 1, 1 1-2, 2 & 2A Univ. & Nos. 1, 1B, 2 & 2B Plain.	10	10	$8 00
*80	No. 5 Vert. Spindle.	10	11	8 00
**81	Ver. Spin. Mil. Attach. for No. 5 Plain Mill. Mch.	12	11	10 00
82	No. 3 Univ. & No. 3 Plain.	12	11	10 00
*83	No. 5 Vert. Spindle.	12	11	12 00
*84	No. 4 Univ. & Nos. 4 & †24 Plain.	12	11	12 00
*85	Nos. 5 & †24 Plain.	12	12	12 00
†86	No. 24 Plain.	12	12	12 00

Arbors marked * are provided with Clutch Collars; those marked ** provided with threaded hole for drawing in bolt; others have Tenons.

For sizes of Tapers, see page 51.

†In ordering give construction number.

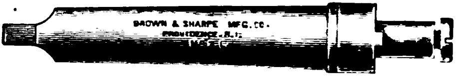
FLY CUTTER ARBORS
FOR MILLING MACHINES.



The hole in the head is 3-4" square.

No. of Arbor.	No. of Machine where used.	No. of Taper.	Price.
110	Nos. 1, 1 1-2, 2 & 2A Univ; Nos. 1, 1B, 2 & 2B Plain.	10	$6 50
112	Nos. 3 and 4 Universal; Nos. 3 and 4 Plain.	11	8 00

ARBORS FOR SHELL END MILLS.



These Arbors are carried in stock for either Right or Left Hand Mills.

In ordering, state whether Arbor is for Right or Left Hand Mill.

No. of Arbor.	Price.	Dia. of Arbor.	Dia. Mills Arbor will take.	Machine where used.	No. Taper.
90	$4 50	3-4"	1 9-16" to 2 3-16	Nos. *3 and *4 Universal; Nos. 00, *0, *3, *4, *5 and 24 Plain; No. *5 Vertical Spdl. Milling Machine; Vertical Spdle. Milling Attachments for Nos. 3 and 4 Universal and Nos. 3, 4 and *5 Plain.	9
91	4 75	1	2 1-4 to 3	Nos. *3 and *4 Universal; Nos. 00, 0, *3, *4, *5 and *24 Plain; No. *5 Vertical Spdl. Milling Machine; Vertical Spdle. Milling Attachments for Nos. 3 and 4 Universal and Nos. 3, 4 and *5 Plain.	9
94	5 25	3-4	1 9-16 to 2 3-16	Nos. 1, 1 1-2, 2 and 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 and 13B Plain.	10
95	5 50	1	2 1-4 to 3	Nos. 1, 1 1-2, 2 and 2A Universal; Nos. 1, 1B, 2, 2B, 12, 13 and 13B Plain.	10
98	5 50	1	2 1-4 to 3	No. 2 Vertical Spindle.	10

Morse Taper furnished when desired.

* Denotes that Arbor is used in Collet.

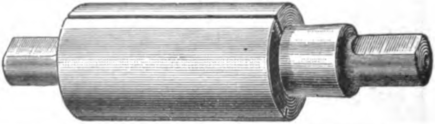
For List of Mills used with above Arbors, see pages 237 and 238.

INDEX PLATES

For Use on Universal Milling Machines.

No.	Machine where used.	Diam. of Plate.	Size of Hole in Centre.	Number of Holes in Each Circle.						Price.
1	No. 1	4 3-4″	1 1-8″	15	16	17	18	19	20	$2 50
2	U. M. M.	4 3-4	1 1-8	21	23	27	29	31	33	2 50
3	Prior to 1900	4 3-4	1 1-8	37	39	41	43	47	49	2 50
7	Nos. 1,	5	1 1-8	15	16	17	18	19	20	2 50
8	1½, 2 & 2A	5	1 1-8	21	23	27	29	31	33	2 50
9	U. M. M.	5	1 1-8	37	39	41	43	47	49	2 50
13	No. 3	6 5-16	1 1-2	15	16	17	18	19	20	3 50
14	U. M. M.	6 5-16	1 1-2	21	23	27	29	31	33	3 50
15		6 5-16	1 1-2	37	39	41	43	47	49	3 50
20	No. 4	6 15-16	1 1-2	15	16	17	18	19	20	3 50
21	U. M. M.	6 15-16	1 1-2	21	23	27	29	31	33	3 50
22	Prior to 1893	6 15-16	1 1-2	37	39	41	43	47	49	3 50
28	No. 4	7 1-2	1 3-4	15	16	17	18	19	20	3 50
29	U. M. M.	7 1-2	1 3-4	21	23	27	29	31	33	3 50
30		7 1-2	1 3-4	37	39	41	43	47	49	3 50

TAPER MANDRELS AND EXPANSION BUSHINGS.



Mandrel No.	Whole Length.	Diam. at Small End.	Price.	Mandrel No.	Whole Length.	Diam. at Small End.	Price.
3	3 11-16″	.3125″	$1 40	9	7 3-16″	.90″	$2 60
4	4 1-16	.35	1 50	10	7 3-4	1.05	3 00
5	4 1-2	.45	1 65	11	8 3-8	1.25	3 50
6	5 1-8	.50	1 80	12	9	1.50	4 00
7	5 15-16	.60	2 00	13	9 5-8	1.75	4 75
8	6 9-16	.75	2 25				

Mandrels take Bushings as follows: No. 3, 2 sizes; Nos. 4, 5, 6, 7 and 8, 3 sizes; Nos. 9, 10, 11, 12 and 13, 6 sizes. List of Bushings on following page.

EXPANSION BUSHINGS.

Outside Diameter of Bushing.	Length.	For Mandrel No.	Price.
1-2"	1 1-2"	3	$ 55
9-16	1 5-8	3	55
5-8	1 3-4	4	65
11-16	1 7-8	4	65
3-4	2	4	65
13-16	2 1-8	5	80
7-8	2 1-4	5	80
15-16	2 3-8	5	80
1	2 1-2	6	95
1 1-16	2 5-8	6	95
1 1-8	2 3-4	6	95
1 3-16	2 7-8	7	1 15
1 1-4	3	7	1 15
1 5-16	3 1-8	7	1 15
1 3-8	3 1-4	8	1 40
1 7-16	3 3-8	8	1 40
1 1-2	3 1-2	8	1 40
1 9-16	3 5-8	9	1 70
1 5-8	3 5-8	9	1 70
1 11-16	3 3-4	9	1 70
1 3-4	3 3-4	9	1 70
1 13-16	3 7-8	9	1 70
1 7-8	3 7-8	9	1 70
1 15-16	4	10	2 00
2	4	10	2 00
2 1-16	4 1-8	10	2 00
2 1-8	4 1-8	10	2 00
2 3-16	4 1-4	10	2 00
2 1-4	4 1-4	10	2 00
2 5-16	4 3-8	11	2 40
2 3-8	4 3-8	11	2 40
2 7-16	4 1-2	11	2 40
2 1-2	4 1-2	11	2 40
2 9-16	4 5-8	11	2 40
2 5-8	4 5-8	11	2 40
2 11-16	4 3-4	12	2 80
2 3-4	4 3-4	12	2 80
2 13-16	4 7-8	12	2 80
2 7-8	4 7-8	12	2 80
2 15-16	5	12	2 80
3	5	12	2 80
3 1-16	5 1-8	13	3 20
3 1-8	5 1-8	13	3 20
3 3-16	5 1-4	13	3 20
3 1-4	5 1-4	13	3 20
3 5-16	5 3-8	13	3 20
3 3-8	5 3-8	13	3 20

List of Taper Mandrels on preceding page.

LATHE MANDRELS.

These Mandrels are of tool steel, hardened and accurately ground. They are tapered .0005" to one inch. The Mandrels from 1-4" to 1" are .0005" below size at the small end; and from 1 1-16" to 2" .001" below size at the small end.

Diameter.	Total Length.	Price.
1-4"	3 1-2"	$ 65
5-16	3 15-16	75
3-8	4 3-8	85
7-16	4 13-16	95
1-2	5 1-4	1 05
9-16	5 11-16	1 15
5-8	6 1-8	1 25
11-16	6 9-16	1 35
3-4	7	1 45
13-16	7 3-8	1 55
7-8	7 3-4	1 70
15-16	8 1-8	1 85
1	8 1-2	2 00
1 1-16	8 7-8	2 10
1 1-8	9 1-4	2 20
1 3-16	9 5-8	2 30
1 1-4	10	2 45
1 5-16	10 3-8	2 60
1 3-8	10 3-4	2 75
1 7-16	11 1-8	2 90
1 1-2	11 1-2	3 10
1 9-16	12	3 30
1 5-8	12	3 50
1 11-16	12	3 70
1 3-4	12	3 90
1 13-16	12	4 10
1 7-8	12	4 35
1 15-16	12	4 60
2	12	4 80

TOOLS FOR USE ON MILLING MACHINES.

The tools in the following lists, we have found by experience to be among those first needed in using these machines.
At the prices stated they can be sold only in full sets. They are shipped with each machine, and, if not wanted, are to be carefully re-packed and returned by express, at our expense.

TOOLS FOR USE ON No. 1 UNIVERSAL MILLING MACHINE.

Screw Arbor, 3-8", 20, L. H., No. 7 Taper, No 120.
One Wrench for Arbor.
Milling Arbor, 7-8", No. 44.
Fly Cutter Arbor with Tool, No. 110.
"A" Collet and Key.
End Mills, 5-16", 3-8" diameter, No. 4 Taper, L. H.
End Mills, 5-8", 1 1-8" diameter, No. 7 Taper, L. H.
Milling Cutter, 1 1-4" diameter, 3-16" face, 3-8", 20, L. H. hole.
Milling Cutter, 2 1-4" diameter, 1 3-4" face, 7-8" hole.
2 Side Milling Cutters, 4" diameter, 5-8" face, 7-8" hole.
Metal Slitting Saw, 2 1-2" diameter, 1-16" face, 7-8" hole.
Angular Cutters, 60°, Right and Left Hand, 3-8", 20, L. H. hole.
Angular Cutter, 60°, Right Hand, 2 1-2" diameter, 7-8" hole.
Cutter for Spiral Mills, 2 1-2" diameter, 7-8" hole.
Weight, ready for shipment, about 25 lbs.

Price, $34 00.

TOOLS FOR USE ON Nos. 1 1-2, 2 & 2-A UNIVERSAL MILLING MACHINES.

Screw Arbor, 3-8", 20, L. H., No. 7 Taper, No. 120.
Milling Arbor, 1", No. 45.
One Wrench for Arbor.
Fly Cutter Arbor and Tool, No. 110.
"A" Collet and Key.
End Mill, 5-16" diam., No. 4 Taper, L. H.
End Mills, 1-2", 3-4", 1 1-4" diam., No. 7 Taper, L. H.
Milling Cutter, 2 1-2" diam., 2" face, 1" hole.
Two Side Milling Cutters, 4" diam., 5-8" face, 1" hole.
Metal Slitting Saw, 3" diam., 1-8" thick, 1" hole.
Angular Cutters, 60°, Right and Left Hand, 3-8", 20, L. H. hole.
Angular Cutter, 60°, Right Hand, 2 3-4" diam., 1" hole.
Cutter for Spiral Mills, 2 3-4" diam., 1" hole.
Weight, ready for shipment, about 60 lbs.

Price, $34 00.

TOOLS FOR USE ON No. 3 UNIVERSAL MILLING MACHINE.

Screw Arbor, 1-2", 16, L. H., No. 9 Taper, No. 122.
Screw Arbor, 1", 10, L. H., No. 11 Taper, No. 130.
Milling Arbor, 1", No. 49.
One Wrench for Arbor.
Fly Cutter Arbor with Tool, No. 112.
"C" Collet and Key.
End Mills, 1-2" and 5-8" diam., No. 5 Taper, L. H.
End Mills, 7-8" and 1 1-4" diam., No. 9 Taper, L. H.
Milling Cutter, 2 1-2" diam., 3" face, 1" hole.
Two Side Milling Cutters, 5" diam., 3-4" face, 1" hole.
Face Mill, 4" diam., 1" face, 1", 10, L. H. hole.
Metal Slitting Saw, 4" diam., 1-8" thick, 1" hole.
Angular Cutters 60°, Right and Left Hand, 1-2", 16, L. H. hole.
Angular Cutter, 60°, Right Hand, 2 3-4" diam., 1" hole.
Cutter for Spiral Mills, 2 3-4" diam., 1" hole.
Weight, ready for shipment, about 60 lbs.

Price, $48 00.

TOOLS FOR USE ON No. 4 UNIVERSAL MILLING MACHINE.

Screw Arbor, 1-2", 16, L. H., No. 9 Taper, No. 122.
Screw Arbor, 1", 10, L. H., No. 11 Taper, No. 133.
Milling Arbor, 1 1-4", No. 66.
One Wrench for Arbor.
One Fly Cutter Arbor, No. 112, with Tool.
One "C" Collet and Key.
End Mills, 1-2" and 5-8" diam., No. 5 Taper. L. H.
End Mills, 3-4", 1" and 1 1-4" diam., No 9 Taper. L. H.
End Mill, Centre Cut, 1 1-2" diam., No. 9 Taper.
Milling Cutters, 1 each—3" diam., 3-8" face, 1 1-4" hole; 3" diam., 5-8" face, 1 1-4" hole; 3" diam., 1 1-4" face, 1 1-4" hole; 3" diam., 2" face, 1 1-4" hole; 3" diam., 3" face, 1 1-4" hole.
Milling Cutter with Nicked Teeth, 3" diam., 4" face, 1 1-4" hole.
Two Side Milling Cutters, 6" diam., 15-16" face, 1 1-4" hole.
Face Mill, 4" diam., 1" face, 1", 10, L. H. hole.
Metal Slitting Saw, 5" diam, 1-8" thick, 1 1-4" hole.
Angular Cutters, 1 each—60°, Right and Left Hand, 1 5-8" diam., 9-16" thick, 1-2", 16, L. H.
Angular Cutters, 1 each—60°, Right and Left Hand, 3" diam., 1-2" thick, 1 1-4" hole.
Cutter for Spiral Mills, 3" diam., 1 1-4" hole.
Weight, ready for shipment, about 75 lbs.

Price, $73 00.

TOOLS FOR USE ON
No. 00 HAND MILLING MACHINE.

End Mills, 1-4", 3-8", 1-2" diameter, No. 5 Taper, L. H.
Spiral End Mills, 11-16", 7-8" diameter, No. 9 Taper, L. H.
Milling Arbor, 7-8" diameter, No. 08 (without Wrench).
Milling Cutter, 2 1-4" diameter, 1-2" face, 7-8" hole.
Milling Cutter, 2 1-4" diameter, 1" face, 7-8" hole.
Two Side Milling Cutters, 2 1-2" diameter, 1-2" face, 7-8" hole.
Metal Slitting Saw, 2 1-2" diameter, 1-8" thick, 7-8" hole.
Weight, ready for shipment, about 15 lbs.

Price, $14 00.

TOOLS FOR USE ON
No. 0 PLAIN MILLING MACHINE.

Screw Feed.

End Mills, 5-16" and 3-8" diam., No. 5 Taper, L. H.
End Mills, 11-16" and 1 1-8" diam., No. 9 Taper, L. H.
Milling Arbor, 7-8", No. 08.
One Wrench for Arbor.
Milling Cutter, 2 1-4" diam., 1-2" face, 7-8" hole.
Milling Cutter, 2 1-4" diam., 1" face, 7-8" hole.
Milling Cutter, 2 1-4" diam., 1 3-4" face, 7-8" hole.
Two Side Milling Cutters, 2 3-4" diam., 1-2" face, 7-8" hole.
Metal Slitting Saw, 2 1-2" diam., 3-32" thick, 7-8" hole.
T Slot Cutter, 11-16" diam., 7-32" thick, No. 5 Taper, No. 16.
Weight, ready for shipment, about 15 lbs.

Price, $17 00.

TOOLS FOR USE ON Nos. 1 and 2
PLAIN MILLING MACHINES.

Milling Arbor, 1", No. 45.
One Wrench for Arbor.
"A" Collet and Key.
End Mill, 5-16" diam., No. 4 Taper, L. H.
End Mills, 1-2", 5-8" and 1 1-8" diam., No. 7 Taper, L. H.
Milling Cutter, 2 1-2" diam., 1-2" face, 1" hole.
Milling Cutter, 2 1-2" diam., 1" face, 1" hole.
Milling Cutter, 2 1-2" diam., 1 1-2" face, 1" hole.
Milling Cutter, 2 1-2" diam., 3" face, 1" hole.
Two Side Milling Cutters, 4" diam., 5-8" face, 1" hole.
Metal Slitting Saw, 3" diam., 1-8" thick, 1" hole.
T Slot Cutter, 15-16"x 9-32", No. 7 Taper, No. 28.
Weight, ready for shipment, about 25 lbs.

Price, $28 00.

TOOLS FOR USE ON Nos. 1-B and 2-B

PLAIN MILLING MACHINES.

Screw Arbor, 3-8", 20, L. H., No. 7 Taper, No. 120.
Milling Arbor, 1", No. 45.
One Wrench for Arbor.
Fly Cutter Arbor and Tool, No. 110.
"A" Collet and Key.
End Mill, 5-16" diam., No. 4 Taper, L. H.
End Mills, 1-2", 3-4", 1 1-4" diam., No. 7 Taper, L. H.
Milling Cutter, 2 1-2" diam., 2" face, 1" hole.
Two Side Milling Cutters, 4" diam., 5-8" face, 1" hole.
Metal Slitting Saw, 3" diam., 1-8" thick, 1" hole.
Angular Cutters, 60°, Right and Left Hand, 3-8", 20, L. H. hole.
Angular Cutters, Right Hand, 60°, 2 3-4" diam., 1" hole.
Weight, ready for shipment, about 60 lbs.

Price, $32 00.

TOOLS FOR USE ON

No. 3 PLAIN MILLING MACHINE.

Milling Arbor, 1 1-4", No. 51 A.
One Wrench for Arbor.
"C" Collet and Key.
End Mills, 1-2" and 5-8" diam., No. 5 Taper, L. H.
End Mills, 7-8" and 1 1-4" diam., No. 9 Taper, L. H.
Milling Cutter, 3" diam., 2" face, 1 1-4" hole.
Milling Cutter, 3 1-2" diam., 3 1-2" face, 1 1-4" hole.
Two Side Milling Cutters, 6" diam., 15-16' face, 1 1-4" hole.
Metal Slitting Saw, 5" diam., 1-8" thick, 1 1-4" hole.
T Slot Cutter, 1 3-16"x 13-32", No. 9 Taper, No. 34.
Weight, ready for shipment, about 60 lbs.

Price, $36 00

TOOLS FOR USE ON Nos. 4 and 24 PLAIN MILLING MACHINES.

Milling Arbor, 1 1-2" diameter, No. 67 A.
One Wrench for Arbor.
"C" Collet and Key.
End Mills, 1-2" and 5-8" diam., No. 5 Taper, L. H.
End Mill, 1" diam., No. 9 Taper, L. H.
End Mill with Centre Cut, 1 1-4" diam., No. 9 Taper, L.H.
Milling Cutter, 4" diam., 1-2" face, 1 1-2" hole.
Milling Cutter, 4" diam., 1" face, 1 1-2" hole.
Milling Cutter, 4" diam., 2" face, 1 1-2" hole.
Milling Cutter with Nicked Teeth, 4" diam., 3" face, 1 1-2" hole.
Milling Cutter with Nicked Teeth, 4" diam., 6" face, 1 1-2" hole.
Metal Slitting Saw, 6" diam., 3-16" face, 1 1-2" hole.
Two Side Milling Cutters, 6" diam., 15-16" face, 1 1-2" hole.
Face Milling Cutter with Inserted Teeth, 8 1-2" diam., 3 1-4", 3 1-2", L. H. hole.
T Slot Cutter, 1 5-16" diam., 17-32" thick, No. 9 Taper, No. 37.
Weight, ready for shipment, about 125 lbs.

Price, $72 00.

TOOLS FOR USE ON No. 5 PLAIN MILLING MACHINE.

Milling Arbor, 1 1-2", No. 71.
Milling Arbor, 2", No. 72.
Two Wrenches for Arbors.
"C" Collet and Key.
End Mills, 1-2" and 5-8" diam., No. 5 Taper, L. H.
End Mill, 1" diam., No. 9 Taper, L. H.
End Mill with Centre Cut, 1 1-2" diam., No. 9 Taper, L. H.
Milling Cutter, 4" diam., 1-2" face, 1 1-2" hole.
Milling Cutter, 4" diam., 1" face, 1 1-2" hole.
Milling Cutter, 4" diam., 2" face, 1 1-2" hole.
Milling Cutter with Nicked Teeth, 4 1-2" diam., 2 1-2" face, 2" hole.
Milling Cutter with Nicked Teeth, 4 1-2" diam., 4" face, 2" hole.
Milling Cutter with Nicked Teeth, 4 1-2" diam., 6" face, 2" hole.
Metal Slitting Saw, 6" diam., 3-16" face, 1 1-2" hole.
Two Side Milling Cutters, 8" diam., 1 3-8" face, 2" hole.
Face Milling Cutter with Inserted Teeth, 9 1-2" diam., 4", 3, L. H. hole.
T Slot Cutter, 1 5-8" diam., 11-16" thick, No. 9 Taper, No. 40.
Weight, ready for shipment, about 225 lbs.

Price, $120 00.

TOOLS FOR USE ON

No. 2 VERTICAL SPINDLE MILLING MACHINE.

Arbor for Shell End Mills, No. 10 Taper, No. 98.
"A" Collet and Key.
Screw Arbor, 3-8", 20, L. H., No. 7 Taper, No. 120.
End Mills, 1-4" and 3-8" diam., No. 4 Taper, L. H.
End Mills, 1-2" and 5-8" diam., No. 7 Taper, L. H.
Spiral End Mills, 7-8" and 1 1-4" diam., No. 7 Taper, L. H.
End Mills with Centre Cut, 1" and 1 1-4" diam., No. 7 Taper, L. H.
Shell End Mills, 3" diam., L. H.
Spiral Shell End Mills, 2 1-4" diam., L. H.
T Slotting Cutters, 15-16" diam., 9-32" thick, No. 7 Taper, No. 28.
Angular Cutters, 60°, R. and L. H., 3-8", 20, L. H. hole.
Weight, ready for shipment, about 40 lbs.

Price, $28 00.

TOOLS FOR USE ON

No. 5 VERTICAL SPINDLE MILLING MACHINE.

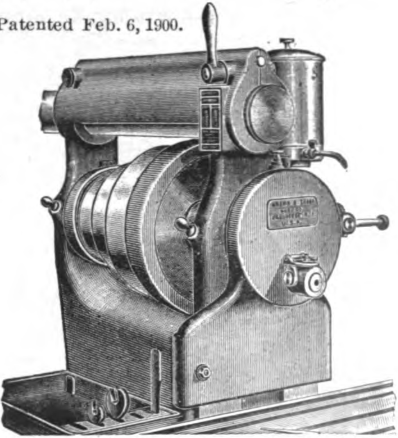
Arbor for Face Mill, No. 11 Taper, No. 80.
"D" Collet and Key.
End Mills, 3-8" and 9-16" diam., No. 5 Taper, L. H.
End Mills, 7-8" and 1 1-4" diam., No. 9 Taper, L. H.
Profiling Cutter, 2 1-2" diam.
Face Mill, 4" diam.
T Slot Cutter, 1 3-16"x 13-32", No. 9 Taper, No. 34.
60° Angular Cutter, 3 3-4" diam.
Inserted Tooth Face Mill, 7 1-2" diam., hole, 3 1-4"x 3 1-2 L.
Weight, ready for shipment, about 85 lbs.

Price, $40 00.

HIGH SPEED MILLING ATTACHMENTS.

For Nos. 1, 1 1-2, 2, 2A, 3 & 4 Universal and Nos. 1, 1B, 2, 2B, 3, 4 & 24 Plain Milling Machines.

Patented Feb. 6, 1900.



This Attachment consists of a bracket that is clamped to the face of the column and an internal gear that is screwed on to the cone spindle that meshes with a pinion upon the spindle of the Attachment.

The Spindle is hardened and ground and runs in a phosphor bronze bearing. The front end has a taper hole.

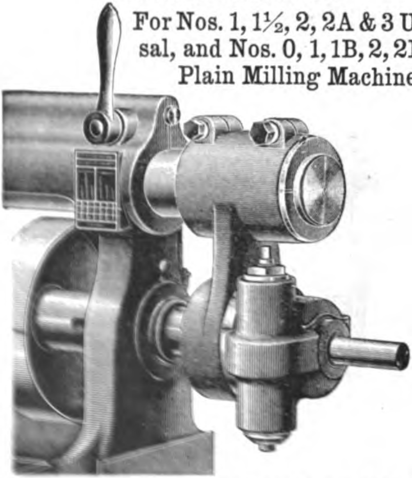
Weights for Shipment: Attachment No. 10, about 40 lbs.; Nos. 11 and 12, about 70 lbs.

Dimensions of Boxes for Shipment: No. 10, 17″x 13″x 8″; Nos. 11 and 12, 19″x 16″x 8″.

No.	Machines where used.	No. Taper Hole in Spindle.	Ratio of Gears.	Speeds. Changes.	Speeds. Range.	Price.
10	1 Universal;	4	5 1-4 to 1	8	292 to 1737	$
	1 & 1B Plain	4	5 1-4 to 1	8	292 to 1737	
10	1 1-2 & 2 Univ;	4	5 1-4 to 1	8	412 to 1659	$
	2 & 2B Plain;	4	5 1-4 to 1	8	412 to 1659	
	2A Universal	4	5 1-4 to 1	8	443 to 1961	
11	3 Universal;	5	4 1-2 to 1	8	360 to 1764	$
	3 Plain	5	4 1-2 to 1	8	360 to 1764	
12	4 Universal;	5	4 1-2 to 1	8	365 to 2191	$
	4 Plain	5	4 1-2 to 1	8	365 to 2191	
	24 Plain	5	4 1-2 to 1	8	877 to 504	

VERTICAL SPINDLE MILLING ATTACHMENTS

For Nos. 1, 1½, 2, 2A & 3 Universal, and Nos. 0, 1, 1B, 2, 2B & 3 Plain Milling Machines.



The Holder or frame is secured to the overhanging arm and the horizontal shaft is inserted in the cone spindle.

The Spindle can be set at any angle from a vertical to a horizontal position. The position is indicated on the base of spindle head, which is graduated.

[illegible]	[illegible]	Greatest Distance [illegible]	Greatest Distance [illegible]	Collet Furnished.	Speeds per Minute.
[illegible]	[illegible]	[illegible]	[illegible]	R	362 to 1047
[illegible]					145 to 860
[illegible]					145 to 860
[illegible]	[illegible]	[illegible]	[illegible]	J	41 to 821
[illegible]					41 to 821
[illegible]					39 to 971
[illegible]	[illegible]	[illegible]	[illegible]	K	25 to 760

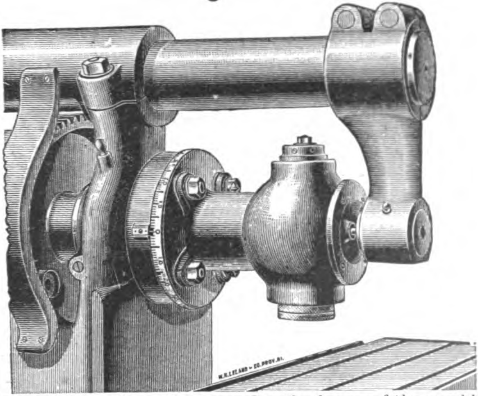
[illegible] Weight for shipment,

[illegible] Weight for shipment,

[illegible] shipment,

VERTICAL SPINDLE MILLING ATTACHMENTS

For Nos. 4, 5 and 24 Plain and No. 4 Universal Milling Machines.



The Holder or frame is secured to the frame of the machine and the horizontal shaft is inserted in the cone spindle.

The Vertical Spindle is driven by the horizontal shaft through bevel gears.

The Spindle can be set at any angle from a vertical to a horizontal position. The position is indicated on the base of spindle head, which is graduated.

No.	Machine where used.	No. Taper Hole in Spindle.	Collet Furnished.	Speed per Min.	Distance from Centre of Spin. to Face of Column or Head.
12	No. 4 Univ. and No. 4 Plain	9	K	9 to 426	9 1-2"
12A	No. 24 Plain	9	K	24 to 157	9 1-2
13	No. 5 Plain	11	O	9 to 345	11

No. 12, **Net Weight,** about 115 lbs. **Weight for shipment,** about 140 lbs. **Price,** $

No. 12A, **Net Weight,** about 115 lbs. **Weight for shipment,** about 140 lbs. **Price,** $

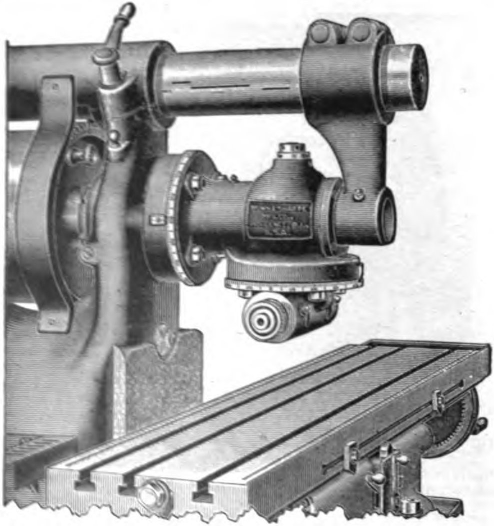
No. 13, **Net Weight,** about 175 lbs. **Weight for shipment,** about 190 lbs. **Price,** $

Dimensions of boxes for shipment: No. 12, 18"x 14"x 11"; No. 12A, 17"x 15"x 11"; No. 13, 21"x 16"x 13".

Collets, pages 46 and 47. Table of Tapers, page 51.

UNIVERSAL MILLING ATTACHMENT No. 12.

For Use on No. 4 Universal, and Nos. 4 and 24 Plain Milling Machines.



This Attachment is secured to the frame of the machine, and the horizontal shaft is inserted in the cone spindle of the machine.

The Spindle of the attachment is driven through bevel gears and can be set at any angle in a vertical or horizontal plane. The position is indicated by graduations reading to degrees. It has a No. 9 Taper Hole.

Speed per minute: No. 4 Universal and No. 4 Plain Milling Machines, 20 to 86; No. 24 Plain Milling Machine, 35 to 229 revolutions per minute.

Distance from centre of spindle to column, 9 1-2".

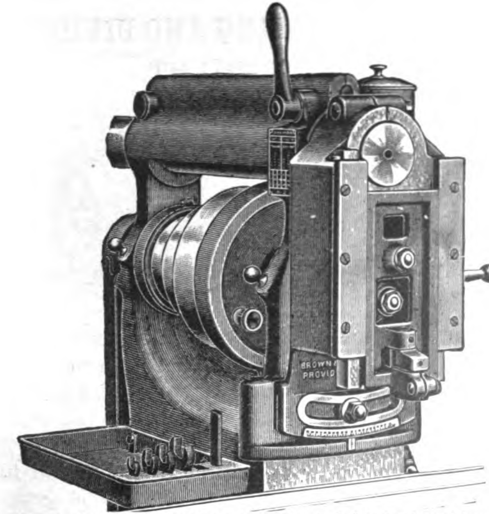
Collet furnished, K.

Net Weight, 150 lbs. W[illegible] shipment, about 190 lbs.

Dimensions of box fo[illegible] 16" x 12".

Price, $

SLOTTING ATTACHMENTS.



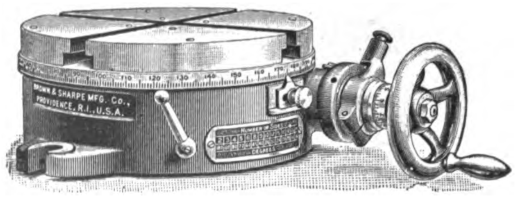
These Attachments are well adapted for tool making of all kinds, as in forming box tools, making templates, splining keyways, etc.

The Tool Slide is driven from the main spindle of the machine by an adjustable crank that allows the stroke to be adjusted as follows: Attachment No. 9, 0 to 1 3-4″; No. 10, 0 to 2″; Nos. 11, 12 and 12A, 0 to 3″. The slide can be set at any angle, between 0 and 10°, either side of the centre line the position being indicated by a scale on the lower part of the frame.

Dimensions of Boxes in which Attachments are shipped: No. 9, 20″x 13″x 9″; No. 10, 24″x 13″x 11″; No. 11, 25″x 16″x 11″; No. 12, 27″x 18 1-2″x 11″; No. 12A, 27″x 18 1-2″x 11″.

No.	Machine where used.	Face of Column to Centre of Tool Holder.	Net Weight.	Shipping Weight.	Price.
9	0 Pl. Mill. Mach.	6 11-16″	70 lbs.	95 lbs.	$
10	1, 1½, 2 & 2A Un; 1, 1B, 2 & 2B Pln	7 1-4	80 "	110 "	$
11	3 Univ; 3 Plain	8 3-8	135 "	170 "	$
12	4 Univ; 4 Plain	8 5-16	180 "	230 "	$
12A	24 Plain	8 5-16	190 "	250 "	$

10 Inch
CIRCULAR MILLING AND DIVIDING ATTACHMENT.



This attachment is found well adapted for use upon Milling Machines, in connection with the Vertical Spindle Milling Attachment and the Slotting Attachment.

The Table is 10″ in diameter, and has 2 T slots, 5-8″ wide. It can be rigidly clamped in position. The entire circumference is graduated to degrees.

The Dial on the worm shaft is graduated to read to 5 minutes. The index finger is adjustable.

The Feed of table is operated by a hand wheel.

The Worm can be thrown out of mesh and the table easily turned by hand.

The attachment is 4 1-2″ high.

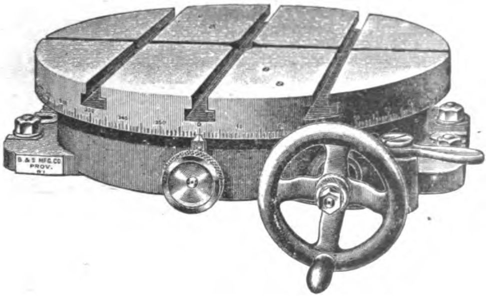
Weight, ready for shipment, about 70 lbs.

Net Weight, about 56 lbs.

Dimensions of box in which attachment is shipped, 19″x 16″x 8″.

Price, $

18 Inch CIRCULAR MILLING ATTACHMENT.



This Attachment is found well adapted for use upon Milling Machines in connection with the Vertical Spindle Milling Attachment.

The Table is 18″ in diameter and has 4 T slots 5-8″ wide. The circumference of the entire circle is graduated to degrees.

The Feed of table is operated by a hand wheel. The worm can be thrown out of mesh and the table easily turned by hand. A clamp screw is provided for clamping the table in position.

The Attachment is 4 5-8″ high.

Weight, ready for shipment, about 255 lbs.

Net Weight, about 225 lbs.

Dimensions of box in which Attachment is shipped, 26″ x 24″ x 8″.

Power Feed. This Attachment is also furnished fitted with Power Feed for use on the No. 2 Vertical Spindle Milling Machine.

Weight, with Power Feed, ready for shipment, about 345 lbs.

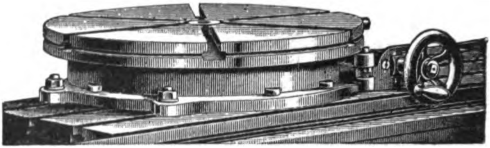
Net Weight, with Power Feed, about 275 lbs.

Dimensions of box in which Attachment is shipped, 30″ x 26″ x 8″.

Price, Attachment with Hand Feed, $

Price, Attachment with Power Feed, $

20 Inch CIRCULAR MILLING ATTACHMENT.



This Attachment for the No. 5 Vertical Spindle Milling Machine is of service in milling circles, segments of circles, circular slots, etc., on plain and irregularly shaped pieces. It is bolted to the table of the machine, and when so placed can be adjusted to any desired position.

The Table is 20″ in diameter and has 6 T slots 3-4″ wide, and is graduated to read to degrees. It remains locked in position when the feed is automatically released.

The Feed of table is positive and automatic and can be automatically released at any point. There are 16 changes of feed.

The Attachment is 5 1-8″ high.

Weight, ready for shipment, about 525 lbs.

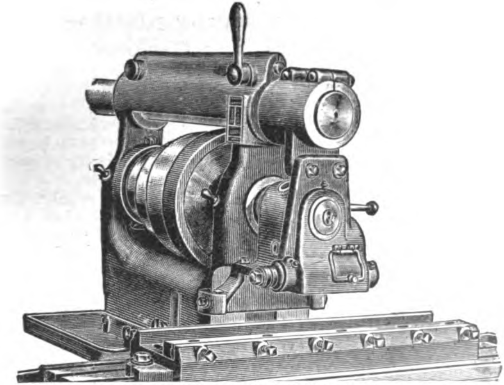
Net Weight, about 420 lbs.

Dimensions of box in which attachment is shipped, 49″x 26″x 11″.

Price, $

In ordering this attachment, give construction number of machine, which is stamped on both the top front of table and top front of ways.

RACK CUTTING ATTACHMENTS.



The cutter spindle is hardened and ground. It is smoothly driven from the main spindle of the machine through spiral and herring-bone gears and runs in phosphor bronze boxes provided with means of compensation for wear.

Cutters for use on the No. 10 Attachment, pages 265 and 273, same as used on No. 3 Automatic Gear Cutting Machines. Cutters for Nos. 11 and 12 Attachments, pages 266 and 273, same as used on No. 4 Automatic Gear Cutting Machines.

The Vise furnished with the No. 10 Attachment has jaws 26″ long and will open 3″; with the Nos. 11 and 12 Attachments the vise has jaws 36″ long and will open 4″.

Weights for Shipment: Attachment No. 10, about 185 lbs.; Nos. 11 and 12, about 400 lbs.

Net Weights: Attachment No. 10, about 135 lbs.; Nos. 11 and 12, about 315 lbs.

Dimensions of boxes for shipment: No. 10, 30″x 16″x 10″; Nos. 11 and 12, 41″x 17″x 15″.

No.	Machine where used.	Diam. of Cutter Spindle.	Distance Centre of Spin. to Bottom of Spin. Head.	Capacity Diametral Pitch.	Price.
10	1, 1 1-2, 2 & 2A Universal; 1B & 2B Plain	1″	1″	Cast Iron, 6 Steel, 8	$
11	3 Universal	1 1-4	1 3-16	Cast Iron, 4 Steel, 6	$
12	4 Universal	1 1-4	1 3-16	Cast Iron, 4 Steel, 6	$
12A	24 Plain	1 1-4	1 3-16	Cast Iron, 4 Steel, 6	$

Scale and Vernier and Indexing Attachment for use on Universal Milling Machines are provided for longitudinal [illegible]

INDEXING ATTACHMENTS.

For Use with Rack Cutting Attachments on Universal Milling Machines.

This Attachment consists of a bracket that can be fastened to the left hand end of the table, for carrying the index plate or locking disk, together with the change gears for gearing to the feed screw. Its use enables racks to be cut and longitudinal settings made without the necessity of relying upon the dial ordinarily used for this purpose.

The Locking Disk, provided with two slots to receive the locking pin, is attached to the adjustable stud on the bracket. A shoe is furnished, that fits either of these slots when a complete revolution is required, thus preventing error.

There are 13 change gears furnished for cutting teeth as follows: diametral pitch, all pitches from 4 to 16 inclusive, all even pitches from 18 to 32 inclusive; ircular pitch, 2" to 8" inclusive. These gears also provide for divisions from 1-8" to 3-4" varying by 16ths.

An Index Table is furnished for use in connection with each one of these attachments.

Machines where used: Attachment No. 10, Nos. 1, 1 1-2 and 2 Universal Milling Machines; No. 11, No. 3 Universal; No. 12, No. 4 Universal.

Price includes change gears, wrenches, etc.

Price, Attachment, No. 10, $ **No. 11, $** **No. 12, $**

SCALE AND VERNIER.

For Longitudinal Adjustment of Table.

The Scale and Vernier are for use in connection with Universal Milling Machines, when it is desired to make exceptionally fine longitudinal adjustments of the table; as, for example, in boring jigs and work of a similar character.

The Scale is 24" long, graduated to 50ths of an inch, and, by means of the Vernier, readings can be made to thousandths of an inch. When in use the Scale is fastened into the trip dog T slot on the front of the table by means of screws that are furnished. The Vernier is held by a single screw attached to the front of the saddle of the machine. It can be used on all of the Universal Milling Machines shown in this catalogue.

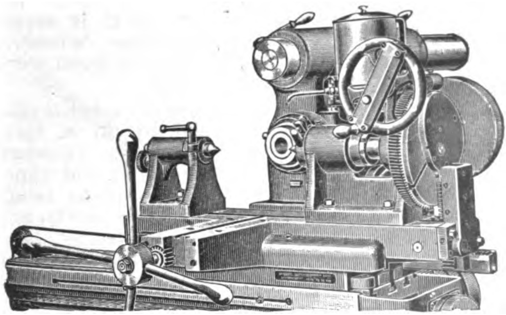
Price, $

When ordering, specify the machine on which the Scale and Vernier are to be used.

No. 10

CAM CUTTING ATTACHMENT.

For Use on Nos. 1, 1 1-2, 2, 2A & 3 Universal, and Nos. 1, 1B, 2, 2B & 3 Plain Milling Machines.



This attachment is used for cutting either Face or Cylindrical Cams from a flat former cut from a disk.

All necessary movements are contained in the attachment itself, allowing the table of the machine to remain clamped in one position during the cutting of the cam.

Cams 12″ in diameter can be cut with any throw to 5″.

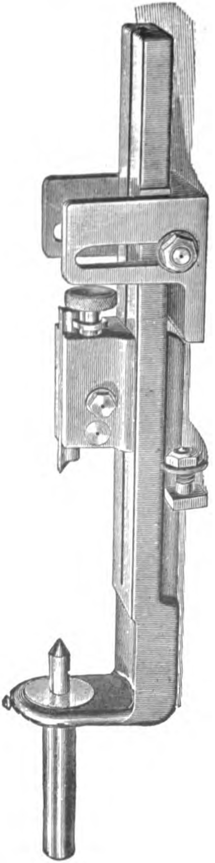
Net Weight, about 570 lbs.

Weight for shipment, about 750 lbs.

Dimensions of box for shipment, approximate, 40″x 28″x 22″.

Price, $

TAPER MILLING ATTACHMENT
FOR
Nos. 1, 1 1-2 and 2 Universal Milling Machines.



This attachment is designed to facilitate the milling of taper work. By reason of its easy and quick adjustment to the desired taper it is especially desirable when a large variety of such work is to be done.

It consists of a table that is suspended on a ring, which in turn is placed on an arbor to fit the taper hole in the spiral head. The head can be set to any desired angle to 10°, and the table will take the same position, keeping the centres always in line. When placed at the required angle it is held in position by a clamp screw that slides in a knee clamped to the table of the machine.

The foot-stock of the attachment slides in a T slot 5-8″ wide, and can be placed to take in work to 4 1-4″ in diameter and 17″ in length.

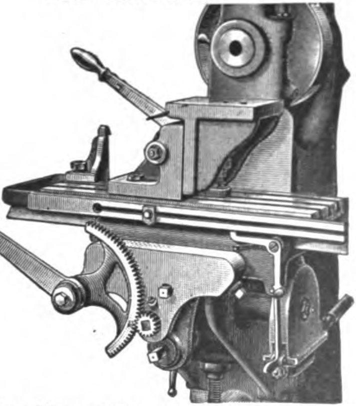
In ordering, give number of machine, which is stamped on the front of frame.

Weight, about 40 lbs.

Price, $

HAND MILLING ATTACHMENT

For No. 0 Plain Milling Machine With Rack Feed.



The No. 0 Plain Milling Machine, Rack Feed, can be quickly changed by means of this attachment into a hand milling machine with or without automatic longitudinal feed.

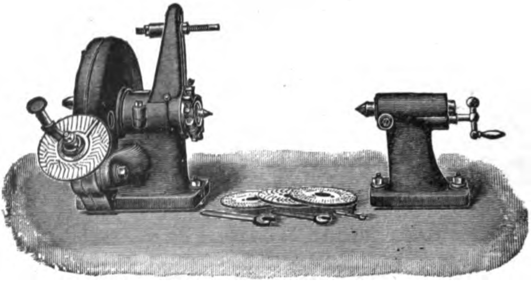
An apron, placed on the outside end of the knee, carries a lever attached to a segment of a gear which runs in a pinion placed over the end of the shaft that moves the table longitudinally, and this lever when moved turns the shaft as the crank would if it were in position.

The attachment, with a knee having a working surface of 8" x 5 3-4", is clamped on the table and on this the fixtures for holding the work can be fastened as on a hand milling machine. When brought to position the lever can be held by the catch in the holder, shown at the left of the cut, which can be released by a latch on the back of the lever, so that at the same time that the knee is returned to position the catch is released without an extra movement. While the lever is held down the feed can be thrown in and milling done as on a plain milling machine.

The top of the knee at its lowest position is 6" from the top of the table and can be raised 2".

With this Attachment in position the milling machine table has a transverse feed of 2 1-4". The longitudinal feed of the table by means of the lever and gear segment is 2 1-4", but with these removed the machine will feed 16" automatically. Net Weight, about 75 lbs. Price, $

GEAR CUTTING ATTACHMENT.



This attachment is used for cutting gears or wheels larger and heavier than can be cut with the usual fixtures belonging to a Milling Machine.

It is exceptionally rigid in construction, and designed to withstand the most severe service to which a tool of this character may be subjected.

The Centres swing 16" in diameter.

The Spindle is large in diameter; the front end is provided with a No. 11 taper hole, and is threaded to receive a face plate or other fixture for holding work. A straight hole, 1 1-4" in diameter, extends from the bottom of the taper hole entirely through the spindle. The spindle can be rigidly clamped in position.

An adjustable rest, placed on the head stock, is provided as a support for the gear while being cut.

The Worm Wheel is 14 1-8" in diameter, and requires 60 revolutions of the worm for one complete revolution. The worm and worm wheel can be disengaged; and a handle at the back provides for turning the spindle by hand for setting or testing work. The worm and worm wheel are accurately cut, and covered to protect them from dust or injury.

The Index Plates divide all numbers to 100, all even numbers to 134; and all numbers divisible by 4 to 200.

The Tongues are reversible, and fit T slots either 5-8" or 3-4 wide.

Combined Length of head and foot-stock, 21 1-2".

Net Weight, about 185 lbs.

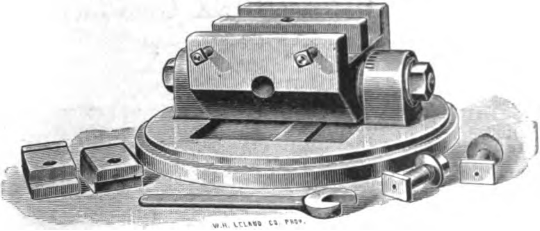
Weight, for shipment, about 290 lbs.

Dimensions of box for shipment. 26"x 23"x 22".

Price includes index plates, and tables explaining the use of same, wrenches, and everything else shown in cut.

Price, $

ADJUSTABLE SWIVEL VISE.



This Vise, designed for use on the No. 2 Surface Grinding Machine, can be set at any angle with the T slots of the table and is pivoted so that it can be set at any angle to 40 degrees either side of the horizontal. A graduated arc indicates this latter position.

The jaws are 5" wide, 1" deep, and will open 2 3-4".

The distance from the bottom of the base to the top of the jaws is 4". **Weight**, about 35 lbs. **Price, $**

An Adjustable Swivel Vise is shipped with each No. 2 Surface Grinding Machine, and if it is not required, please pack carefully and return by express at our expense.

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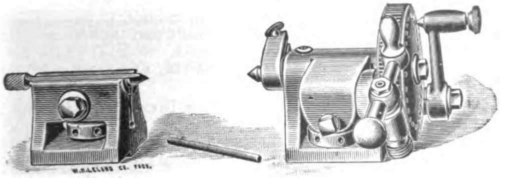
4 3-4 in. INDEX CENTRES.

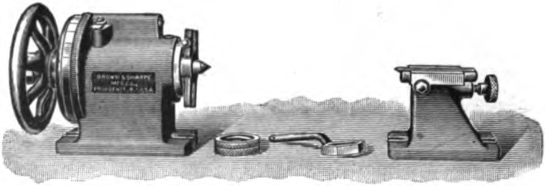


These Index Centres, designed for use on the No. 2 Surface Grinding Machine, are convenient for grinding taps, reamers, formed cutters and work of a similar class.

The Index Plate has 24 holes and can be turned by a worm, or the worm can be disengaged and the plate turned by hand. The centres swing 4 3-4" in diameter and take 10 1-2" in length. **Weight**, about 10 lbs. **Price, $**

A pair of Index Centres is shipped with each No. 2 Surface Grinding Machine and if not required, please pack carefully and return by express at our expense.

8 Inch and 12 Inch
SINGLE DIAL INDEX CENTRES.



These Index Centres are convenient for use onmilling or other machines where rapid indexing is to be done, as in cutting teeth in sprocket wheels, mills, or in milling nuts, etc., and swing respectively 8″ and 12″ in diameter.

The Spindles are threaded on the ends, and provided with No. 11 taper holes.

The Foot-stocks are provided with adjustable centres, but can be furnished with bearings instead of adjustable centres when desired.

The Index Plates are dials provided with hardened steel bushings, and covered, thus protecting the holes from dirt. The plates are locked by a hardened steel taper pin, which is forced into the bushing by a spring. It can be released by a lever, and the work rotated by a hand wheel, thus making the indexing very rapid. While the plates can be used, usually, for other than the number of teeth for which they are made, it is desirable to have them contain holes for the number of teeth to be cut, as mistakes can thus be avoided.

The Dials furnished have 24 holes. Special dials for 8″ centres with any number of holes to 30, and for the 12″ centres to 36 holes, made to order.

The Reversible Tongues and Bolts furnished with the 8″ and the 12″ fit a T slot 5-8″ or 3-4″ wide.

Net Weights: 8″, without Table, about 50 lbs., with Table, about 180 lbs.; 12″, without Table, about 110 lbs., with Table, about 230 lbs.

Weights for Shipment: 8″, without Table, about 80 lbs.; 12″, without table, about 160 lbs.

Dimensions of boxes for shipment: 8″, 20″ x 10″ x 12″; 12″, 26″ x 13″ x 14″.

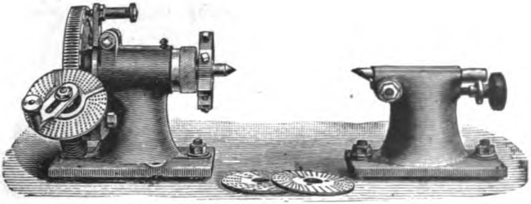
Price, 8″, without Table, $ with Table, $

Price, 12″, without Table, $ with Table, $

Price, Special Dials, for 8″, $ each; for 12″, $ each.

For List of Tables, see page 86.

10 In. PLAIN INDEX CENTRES.



The Centres swing 10 1-4" in diameter.

The Spindle is threaded on front end and has a No. 10 taper hole. The straight hole at end of taper is 1 1-16" in diameter.

The Worm Wheel is 6 1-2" in diameter, and one revolution is made by 40 revolutions of index crank. It has 24 holes and when the worm is disengaged direct indexing can be done and the wheel held by means of an index pin.

The Index Plates are the same as used on the Nos. 1, 1 1-2 and 2 Universal Milling Machines, see page 54.

The Head-stock can be clamped at any angle on table.

The Tongues and Bolts furnished fit a T slot 5-8" wide. The tongues are inserted.

Combined Length of head and foot-stocks, 13 3-4".

Price includes index plates and tables explaining the use of same, wrenches, and everything else shown in cut.

Net Weight, without Table, about 55 lbs.; with Table, about 155 lbs.

Weight for Shipment: Without Table, about 70 lbs.

Dimensions of box for shipment, 16" x 13" x 11".

Price, without Table, $ **Price,** with Table, $

---

12 In. PLAIN INDEX CENTRES.

These Centres are of the same general design as the 10" Index Centres described above.

The Centres swing 12 1-4" in diameter.

The Worm Wheel is 7 3-4" in diameter.

The Tongues and Bolts furnished fit a T slot 3-4" wide.

Combined Length of head and foot-stocks, 16 3-4".

Price includes index plates and tables explaining the use of same, wrenches, and everything else shown in cut of 10" Index Centres.

Net Weight, without Table, about 65 lbs.; with Table, about 175 lbs.

Weight for shipment, without Table, about 85 lbs.

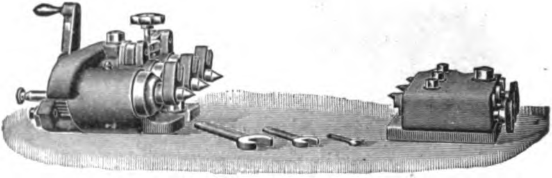
Dimensions of box for shipment, 19" x 14" x 13".

Price, without Table, $ **Price,** with Table, $

For List of Tables, see page 86.

No. 2 1-2 TRIPLE INDEX CENTRES.

For Direct Indexing Only.



These index centres are convenient for use on Milling or other machines. They are well adapted for grooving taps and reamers, milling nuts, cutting small gears and other work of a similar character.

The Centres swing, using the three spindles 2 1-2″, using the two outside spindles 5″. The spindles are operated simultaneously by the movement of the index crank and clamped simultaneously by means of a thumb screw on front of head-stock.

The Index Plate furnished divides all numbers as follows: 2, 3, 4, 5, 6, 7, 8, 12, 14, 20 and 24.

The Foot-stock is provided with adjustable centres that can be clamped.

Combined Length of head and foot-stock 13 1-2″.

The Tongues are reversible and fit T slots either 1-2″ or 5-8″ wide.

Weight of Centres ready for shipment, about 100 lbs.

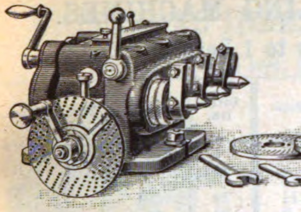
Net Weight, about 75 lbs.

Dimensions of box in which centres are shipped 21″x12″x10″.

Price includes everything shown in cut, boxed and delivered f. o. b., Providence, R. I.

Price,

No. 14 TRIPLE INI



The Centres swing, using the th
two outside spindles, 8″.

The Spindles are operated sim
ment of the index crank. The fr
provided with No. 10 taper holes;
taper is 1 1-16″ in diameter. The
the head clamps all three spindle

The Index Plates divide all nu
numbers to 100. A plate for rapid
directly on the centre spindle, and
ing is desired, the worm, which t
quickly out of gear by means of
head-stock.

The Foot-stock is provided with

Combined Length of head and f

The Tongues and Bolts furnish
T slot 5-8″ or 3-4″ wide.

Weight of Centres ready for sh

Net Weight, about 150 lbs.

Dimensions of box in which ce
x 12″.

Price includes three index plate
use of same, wrenches, and eve
boxed and delivered f. o. b. Prov

Price, $

No. 4 TRIPLE INI

For Direct Inde

These Centres are of the same
as the No. 14, excepting that th
Indexing only.

Price includes wrenches, etc., b
Providence, R. I.

Price, $

INDEX TABLE
FOR MILLING MACHINES.
40 Turns to 1 Revolution.

Division.	Circle.	Turns.	Holes.
2	any	20	...
3	39	13	13
	33	13	11
	27	13	9
	21	13	7
	18	13	6
	15	13	5
4	any	10	....
5	any	8	...
6	39	6	26
	33	6	22
	27	6	18
	21	6	14
	18	6	12
	15	6	10
7	49	5	35
	21	5	15
8	any	5	...
9	27	4	12
	18	4	8
10	any	4	..
11	33	3	21
12	39	3	13
	33	3	11
	27	3	9
	21	3	7
	18	3	6
12	15	3	5
13	39	3	3
14	49	2	42
	21	2	18
15	39	2	26
	33	2	22
	27	2	18
	21	2	14
	18	2	12
	15	2	10
16	20	2	10
	18	2	9
	16	2	8
17	17	2	6

Division.	Circle.	Turns.	Holes.
18	27	2	6
	18	2	4
19	19	2	2
20	any	2	...
21	21	1	19
22	33	1	27
23	23	1	17
24	39	1	26
	33	1	22
	27	1	18
	21	1	14
	18	1	12
	15	1	10
25	20	1	12
26	39	1	21
27	27	1	13
28	49	1	21
	21	1	9
29	29	1	11
30	39	1	13
	33	1	11
	27	1	9
	21	1	7
	18	1	6
	15	1	5
31	31	1	9
32	20	1	5
	16	1	4
33	33	1	7
34	17	1	3
35	49	1	7
	21	1	3
36	27	1	3
	18	1	2
37	37	1	3
38	19	1	1
39	39	1	1
40	any	1	...
DEGREES.			
1	18	...	2

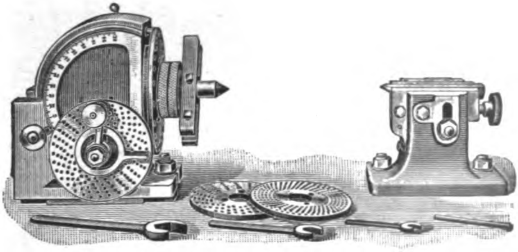
AMERICAN MACHINIST, AUG. 24, 1899.

For Index Plates, see page 54.

10 Inch

UNIVERSAL INDEX CENTRES.

Patented Feb. 5, 1884; Feb. 14, 1893.



The Centres swing 10″ in diameter.

The Head can be set at any angle from 10 degrees below the horizontal to 30 degrees beyond the perpendicular.

The Spindle has a No. 10 taper hole. The straight hole at end of taper is 1 1-16″ in diameter. The front end is threaded.

The Foot-stock Centre can be raised vertically and set at an angle in a vertical plane.

Combined Length of head and foot stock, 17″.

The Index Plates divide all numbers to 50, all even numbers to 100 and a large number beyond.

The Tongues and Bolts furnished fit a T slot 5-8″ wide. The tongues are inserted.

Net Weight, without Table, about 85 lbs.; with Table, about 200 lbs.

Weight, for shipment, without Table, about 100 lbs

Dimensions of box for shipment, 16″x 13″x 12″.

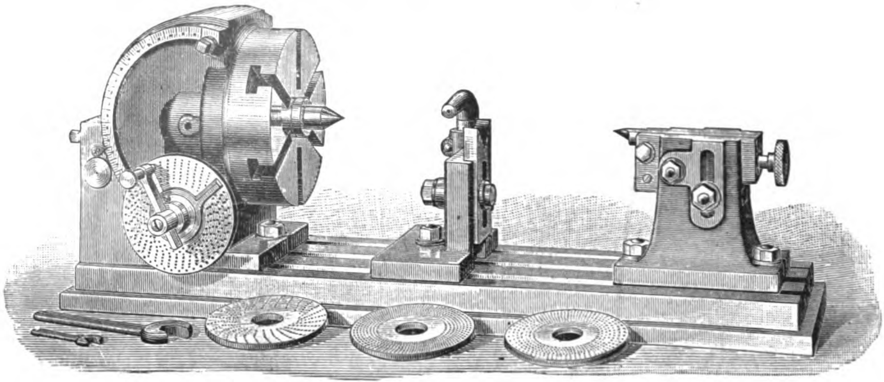
Price includes index plates and tables explaining the use of same.

Price, without Table, $ **Price,** with Table, $

For List of Tables, see page 86.

12 1-2 Inch
UNIVERSAL INDEX CENTRES.

Patented Feb. 5, 1884; Feb. 14, 1893.



12 1-2 Inch

UNIVERSAL INDEX CENTRES.

The Centres swing 12 1-2″ in diameter.

The Head can be set at any angle from 10 degrees below the horizontal to 10 degrees beyond the perpendicular.

The Spindle is provided with a face plate and adjustable dog carrier. The front end has a No. 12 taper hole. The straight hole at end of taper is 1 1-2″ in diameter.

The Worm Wheel is 6″ in diameter, and one revolution is made by 60 revolutions of index crank.

The Foot-stock Centre can be raised vertically and set at an angle in a vertical plane.

The Index Plates divide all numbers to 100, all even numbers to 134 and all numbers divisible by 4 to 200.

The Table is provided with flanges, is 32″ long, 8″ wide, and has 3 T slots 3-4″ wide.

Combined Length of head and foot-stock, 18″.

Centre Rest will take work to 3 1-8″ in diameter.

Net Weight, with table, about 275 lbs.; without table, about 145 lbs.

Weight for shipment, with table, about 340 lbs ; without table, about 220 lbs.

Dimensions of box for shipment, with table, 39″x 16″x 17″; without table, 23″x 17″x 15″.

Price includes index plates and tables explaining the use of the same, wrenches and everything else shown in cut.

Price, without table, $

Price, with table, $

TABLES FOR INDEX CENTRES.

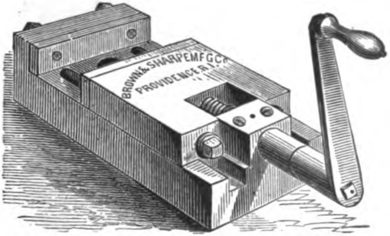
These Tables are provided with flanges; and, excepting that for the 12 1-2" Universal Index Centres, with oil pans and channels.

Index Centres, Where Used.	Length Over All.	Width Over All.	Working Surface.	Width of T Slot.	Combined Length of Head and Foot Stock.	Weight.	Price.
8" Single Dial	37 3-4"	7 3-4"	30 3-4"x 5 1-4"	5-8"	18 1-2"	110 lbs.	$
10" Plain	37 3-4	7 3-4	30 3-4 x 5 1-4	5-8	13 3-4	110 "	$
10" Universal	37 3-4	7 3-4	30 3-4 x 5 1-4	5-8	17	110 "	$
12" Single Dial	39 1-4	8 3-4	32 x 6	3-4	17	140 "	$
12" Plain	39 1-4	8 3-4	32 x 6	3-4	17 1-4	140 "	$
12 1-2" Universal	33	9	32 x 8	3-4	18	140 "	$

For Index Centres, see pages 77 to 85.

PLAIN VISES

For Use Upon Milling or Planing Machines.

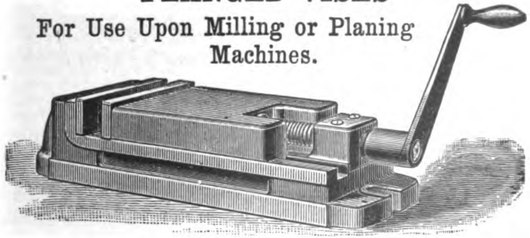


Size.	Price.	Width of Jaw.	Depth of Jaw.	Jaws Open.	Weight.
No. 1	$12 00	3 5-8″	15-16″	1 1-2″	10 lbs.
" 2	13 00	5 1-8	1 1-4	2 3-4	24 "
" 3	18 00	6 1-8	1 9-16	3 5-8	43 "

The jaws are of steel and hardened unless otherwise specified.

FLANGED VISES

For Use Upon Milling or Planing Machines.



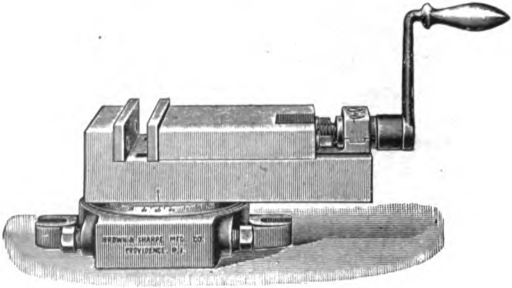
These Vises are provided with flanges for clamping them to the table of Milling or Planing Machines.

Size.	Price.	Width of Jaws.	Depth of Jaws.	Jaws Open.	Weight.
No. 1	$13 50	4 1-8″	1 1-16″	2″	16 lbs.
" 2	15 00	5 1-8	1 1-4	2 3-4	28 "
" 3	23 00	6 1-8	1 9-16	3 5-8	50 "
" 4	34 00	7 1-8	2	4 1-2	95 "

The jaws are of steel and hardened unless otherwise specified.

SWIVEL VISES

For Use Upon Milling or Planing Machines.



These vises are especially convenient for angular milling or planing. The base is double, and the upper portion is graduated so that the vise may be set at any angle with the ways of the machine.

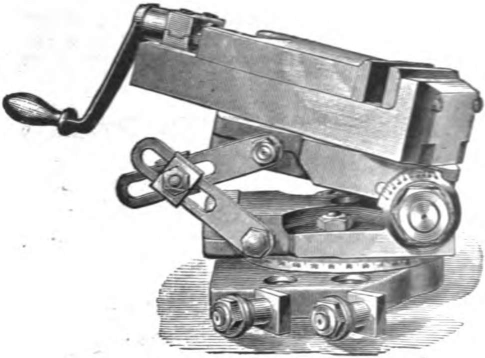
An improved method of clamping the lower and upper portions of the base insures great rigidity and compactness.

The No. 2 Vise can be used with the Nos. 1 and 2 Universal and Nos. 1 and 2 Plain Milling Machines, and the No. 3 with Nos. 3 and 4 Universal and Nos. 3, 4, 5 and 24 Plain Milling Machines.

Sizes.	Price.	Height.	Width of Jaws.	Depth of Jaws.	Jaws Open.	Net Weight.
No. 2	$18 00	4 1-2″	5 1-8″	1 1-4″	2 3-4″	88 lbs.
No. 3	25 00	5 3-16	6 1-8	1 9 16	3 5-8	70 "

The jaws are hardened unless otherwise specified.

TOOL MAKERS UNIVERSAL VISES.



No.	Width of Jaws.	Depth of Jaws.	Jaws Open.	Net Weight.	Shipping Weight	Price.
2	5 1-8"	1 1-4"	2 3-4"	67 lbs.	80 lbs.	$45 00
3	6 1-8	1 9-16	3 5-8	130 lbs.	150 lbs.	60 00

The base is double. The lower part is provided with a tongue, and is fastened to the table by two bolts, which fit into the table T slots. It has two sets of holes to allow for moving the vise back when set in a vertical plane. The upper part is a hinged knee, which swivels on the lower part of the base. The lower part of the knee is graduated and can be set at any angle in a horizontal plane. The upper part of the knee is hinged to the lower part in such a manner that it can be set at any angle, to 90°, in a vertical plane and clamped rigidly in position by the nut on end of bolt forming the hinge, and the bracing levers shown at left of cut. The upper surface is graduated for setting the vise proper. The bolt forming the hinge is provided with a hardened steel dial graduated to 90°. The bracing levers are held in position by the bolt shown in centre, and the bolts at the ends of the levers.

The vise proper swivels on the upper part of the hinged knee, can be set at any angle to the axis of the bolt forming the hinge and clamped in position by the bolt which holds the upper bracing lever.

The jaws are made of tool steel, hardened. Each vise is furnished with suitable wrenches.

Dimensions of boxes in which vises are shipped: No. 2, 15"x 12"x 9"; No. 3, approximate, 20"x 15"x 10".

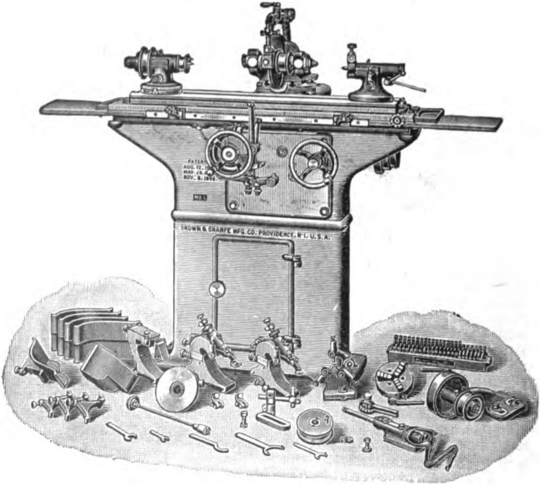
Price of No. 3 furnished upon application.

No. 1

8 in. x 24 in.

UNIVERSAL GRINDING MACHINE.

Patented August 12, 1890; May 26, 1891;
November 8, 1898; June 30, 1903.



This machine swings 8″ in diameter and takes 24″ in length.

No. 1

8 in. x 24 in.

UNIVERSAL GRINDING MACHINE.

With Automatic Feeds.

The Wheel Spindle is hardened, ground and lapped and runs in self aligning bronze boxes provided with means of compensation for wear. It will take wheels to 8" in diameter and 3-8" face.

The Wheel Stand Slide swivels and has a graduated base. When the Internal Grinding Fixture, page 98, is used, the wheel stand is removed and a speed counter substituted.

The Transverse Movement of wheel stand is adjusted by a hand wheel graduated to read to thousandths of an inch on the diameter of the work.

The Automatic Cross Feed gives a range of feed varying from .00025" to .004" to each reversal of table and can be automatically released at any point.

The Swivel Table turns on a central stud. It can be set at an angle to the ways. This adjustment is made by means of a screw at the end of table and scales, graduated to read to 3 1-2 degrees either side of centre line and to 1 1-2" taper per foot, indicate its position. It has a T slot 5-8" wide.

The Travel of Table is automatic in either direction and controlled by dogs operating against the reversing lever. The dog brackets slide upon a rack and are held in position by a spring latch that prevents the dogs slipping. The dogs can be raised and the table moved beyond the reversing points without changing the adjustment.

The Head-stock is clamped to swivel table. It swivels and has a graduated base. The spindle is hardened, ground and lapped and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a taper hole. The spindle can be locked and, with a pulley on the end, grinding can be done on dead centres.

The Foot-stock is clamped to swivel table by bolt and nut. The spindle can be quickly operated by a lever. The spindle has a taper hole.

The Head and Foot-stock Centres swing 8" in diameter and take 24" in length.

Wet Grinding is amply provided for. Provision is made for a liberal supply of water; the supply pipes are large. Water guards, channels and pans protect the floor and return the waste water to the settling tank and pump. The wheel guard is heavy and of such form as to catch the spray and waste water from the wheel.

The Counter-shaft has tight and loose pulleys 8" in diameter for 3" belt and should run 280 revolutions per minute.

Weight of machine ready for shipment, about 2750 lbs.

Net Weight, about 2120 lbs. **Floor Space**, 36" x 92".

Dimensions of box in which machine is shipped, 71"x 39" x 54".

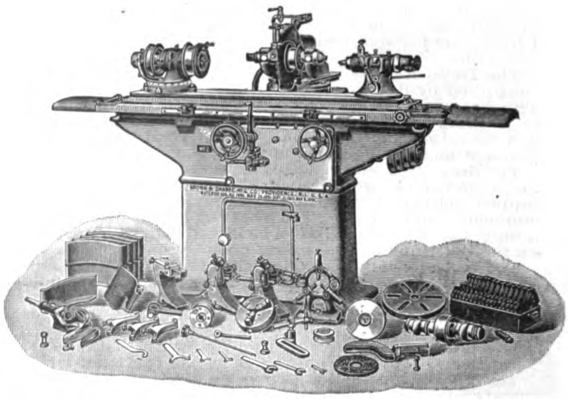
Price includes No. 03 Internal Grinding Fixture, 4" 3-jawed chuck, centre rest, plain back rest, 2 universal back rests, set of telescopic water guards, emery wheel, set of dogs, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

No. 2

12 in. x 30 in.

UNIVERSAL GRINDING MACHINE.

Patented Aug. 12, 1890; May 26, 1891; Sept. 21, 1897; Nov. 8, 1898; June 30, 1903.



This machine swings 12″ in diameter, and takes 30″ between centres.

No. 4 12 in. x 60 in.
UNIVERSAL GRINDING MACHINE.
With Automatic Feeds.

The Wheel Spindle is hardened, ground and lapped and runs in self-aligning bronze boxes provided with means of compensation for wear. It will take wheels to 12" in diameter and from 1-2" to 1" face.

The Wheel Stand Slide swivels and has a graduated base. When the Internal Grinding Fixture, page 98, is used, the wheel arbor is removed and a speed spindle substituted.

The Transverse Movement of wheel stand is adjusted by a hand wheel graduated to read to thousandths of an inch on the diameter of the work.

The Automatic Cross Feed gives a range of feed varying from .00025" to .004" to each reversal of table and the feed can be automatically released at any point.

The Swivel Table turns on a central stud. It can be set at an angle to the ways. This adjustment is made by means of a screw at the end of table; and scales, graduated to read to 3 1-2 degrees either side of centre line and 1 1-2" taper per foot, indicate this position. It has a T slot 3-4" wide.

The Travel of Table is automatic in either direction and controlled by adjustable dogs operating against the reversing lever. The dog brackets slide upon a rack and are held in position by a spring latch that prevents the dogs slipping. The dogs can be raised and table moved beyond reversing points without changing the adjustment.

The Head-stock swivels and has a graduated base. The spindle is hardened, ground and lapped and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a taper hole.

The Foot-stock is clamped to swivel table by a lever. The front end of spinde has a taper hole.

The Head and Foot-stock Centres swing 12" in diameter and take 60" in length.

Wet Grinding is amply provided for. Provision is made for a liberal supply of water; the supply pipes are large. Water guards, channels and pans protect the floor and return the waste water to the settling tank and pump. The wheel guard is heavy and of such form as to catch the spray and waste water from the wheel.

The Counter-shaft has tight and loose pulleys 12" in diameter for 3 1-2" belt and should run from 300 to 320 revolutions per minute.

Weight of machine ready for shipment, about 6130 lbs.

Net Weight, about 4900 lbs. **Floor Space,** 50" x 207".

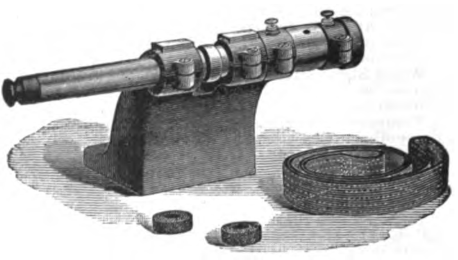
Dimensions of box in which machine is shipped, 121" x 55" x 48".

Price includes No. 4 Internal Grinding Fixture, 6" 3-jawed chuck, back rest with water guards, 2 universal back rests, centre rest, 2 emery wheels, set of dogs, set of telescopic water guards, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. Price, $

For Attachments, see pages 120 to 122.

INTERNAL GRINDING FIXTURES.

Patented June 10, 1890.



This is an improvement upon earlier fixtures, and with it holes can be readily and accurately ground.

Formerly it was customary to employ a solid spindle or shaft, with a driving pulley at one end and a small wheel at the other end. To grind holes of any considerable depth the end of the spindle projected a corresponding distance beyond the bearing, and any motion or play in the bearing was multiplied at the end of the spindle so that even a slight motion or play in the bearing caused a considerable movement at the end of the spindle and necessarily produced imperfect work. In order to give it sufficient rigidity the spindle was made of a considerable diameter, but this large diameter rendered impossible the attainment of the high speed requisite for thoroughly efficient work. Also, when pressure was brought upon the end of the spindle by the action of the wheel upon the work, this pressure tended to force the spindle against its bearing with considerable power, owing to the leverage, due to the distance between the grinding wheel and the bearing, and this produced a great amount of friction between the spindle and the bearing and tended to prevent the attainment of high speeds.

The present fixture overcomes these difficulties. It consists, primarily, of a grinding spindle of comparatively small size, mounted in a bearing of telescopic tubes of sufficiently large diameter, to give the required rigidity. These tubes are adjustable, longitudinally relatively to each other, and furnish a support or bearing for the spindle in close proximity to the grinding wheel. The small diameter of the spindle enables it to be run at the required high speeds.

Provision is made for excluding dust from the bearings.

One of these fixtures is sent with and included in the price of each of our Universal Grinding Machines.

Capacity of Internal Grinding Fixtures.

No. of Fixture.	No. of Machine where used.	Distance from Bottom of Stand to Centre of Spindle.	Length that can be Ground.	Diameter of Hole that can be Ground.	Diameter of Hole in Wheel.	Speed, Revolutions, per Minute.
01	1	3″	1 1-2″	1-4″ to 1-2″	3-32″	16800
1	2, 3 and 4	4 5-8	1 1-2	1-4 to 1-2	3-32	16800
02	1	3	3 3-4	7-16 to 7-8	1-4	13400
2	2, 3 and 4	4 5-8	3 3-4	7-16 to 7-8	1-4	13400
03	1	3	5 1-4	3-4 to 1 1-8	1-4	12200
3	2, 3 and 4	4 5-8	5 1-4	3-4 to 1 1-8	1-4	12200
04	1	3	6	1 and upward	5-8	11200
4	2, 3 and 4	4 5-8	6	1 and upward	5-8	11200
5	2, 3 and 4	4 5-8	8	2 and upward	3-4	8050

Fixture No. 03 is sent with the No. 1 Universal Grinding Machine.

Fixture No. 4 is sent with the Nos. 2, 3 and 4 Universal Grinding Machines Improved.

If any other size is preferred it will be forwarded at the expense of the customer, the fixture sent with the machine being returned without expense to us.

Price includes 2 emery wheels and everything else shown in cut.

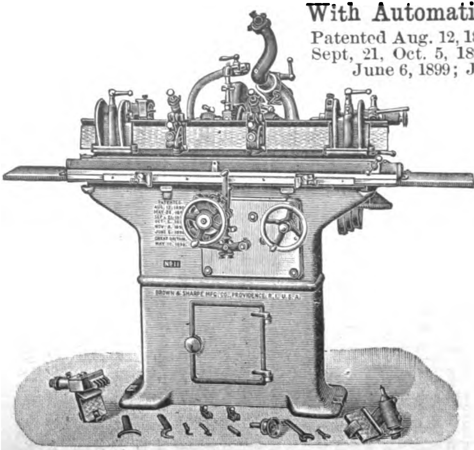
Price, Nos. 02, 03, 04, 2, 3, 4, 5; $

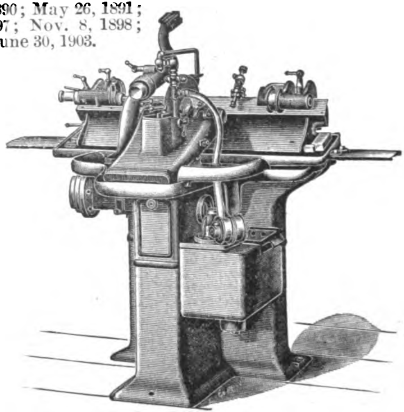
Price, Nos. 1, 01; $ Special sizes made to order.

No. 11 4 in. x 30 in. PLAIN GRINDING MACHINE.

With Automatic Feeds.

Patented Aug. 12, 1890; May 26, 1891;
Sept, 21, Oct. 5, 1897; Nov. 8, 1898;
June 6, 1899; June 30, 1903.





This machine will grind work to 4″ in diameter, either straight or taper to 1 3-4″ per foot, and to 30″ in length.

No. 11

4 in. x 30 in.

PLAIN GRINDING MACHINE.

With Automatic Feeds.

The Wheel Spindle is hardened, ground and lapped, and runs in self-aligning bronze boxes provided with means of compensation for wear. It will take wheels to 12" in diameter and from 1-2" to 3-4" face.

The Wheel Slide is adjusted by a hand wheel and dial. The dial is graduated to read to thousandths of an inch on the diameter of the work.

The Automatic Cross Feed sizes the work to within .00025". The simple pressing of a thumb latch regulates the feed; the mechanism doing the sizing correctly.

The Swivel Table turns on a large central stud, which is hardened and ground. It can be set at an angle to the ways. This adjustment is made by means of a screw at the end of the table; and a scale, graduated to read to 1 3-4" taper per foot either side of the centre line, indicates the adjustment.

The Travel of Table is automatic in either direction; and controlled by dogs, which are easily adjusted, operating against a sliding pin on the reversing lever.

The Head-stock is clamped to the swivel table.

The Foot-stock is clamped to the swivel table. The spindle is adequately protected from water and emery grit. It is quickly operated by a lever.

Wet Grinding is amply provided for. The side of the swivel table toward the wheel is entirely closed, thus protecting the guiding ways of the head and foot-stock and avoiding the necessity of water guards. A large pump and suitable piping provides for an abundant supply of water.

The Follow Rest is held in an overhanging arm, and can be easily turned out of the way or placed in position.

The Counter-shaft has tight and loose pulleys 12" in diameter for 3 1-2" belt, and should run from 300 to 320 revolutions per minute.

Weight of machine ready for shipment, about 3225 lbs.

Net Weight, about 2475 lbs.

Floor Space, 41" x 105".

Dimensions of box in which machine is shipped, 78" x 46" x 59".

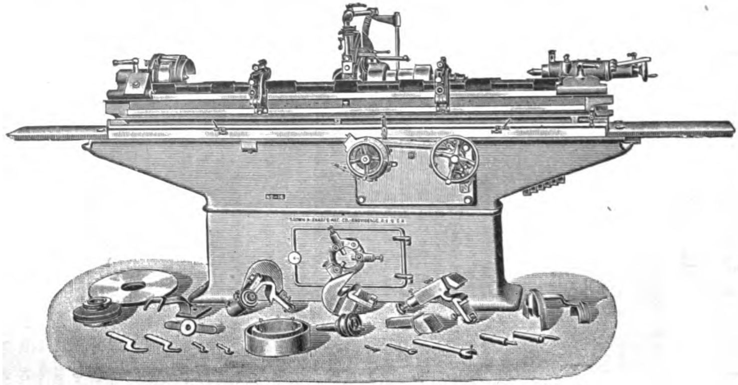
Price includes plain back rest, 2 universal back rests, set of dogs, centre grinding attachment; 1, 12" emery wheel, 1-2" face, 5" hole; wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Attachments, see pages 120 to 122.

No. 14 10 in. x. 48 in.
PLAIN GRINDING MACHINE.

Patented Aug. 12, 1890; May 26, 1891; Sept. 21, Oct. 5, 1897; Nov. 8, 1898; June 6, 1899; June 30, 1903.



This machine will grind work to 10″ in diameter, either straight or taper to 2″ per foot and 48″ in length.

No. 14

10 in. x 48 in.

PLAIN GRINDING MACHINE.

With Automatic Feeds.

The Wheel Spindle is hardened, ground and lapped, and runs in self aligning bronze boxes provided with means of compensation for wear. It will take wheels to 18" in diameter and from 3-4" to 1 1-2" face.

The Wheel Slide is adjusted by a hand wheel and dial. The dial is graduated to read to thousandths of an inch on the diameter of the work.

The Automatic Cross Feed sizes the work to within .00025". The simple pressing of a thumb latch regulates the feed; the mechanism doing the sizing correctly.

The Swivel Table turns on a large central stud, which is hardened and ground. It can be set at an angle to the ways. This adjustment is made by means of a screw at the end of the table; and a scale, graduated to read to 2" taper per foot either side of the centre line, indicates the adjustment.

The Travel of Table is automatic in either direction, and controlled by dogs, which are easily adjusted, operating against a sliding pin on the reversing lever.

The Head-Stock is clamped to the swivel table.

The Foot-Stock is clamped to the swivel table. The spindle is adequately protected from water and emery grit. It is quickly operated by a lever.

Wet Grinding is amply provided for. Provision is made for a liberal supply of water; the supply pipes are large. Water guards, channels and pans protect the floor and return the waste water to the settling tank and pump. The wheel guard is heavy and of such form as to catch the spray and waste water from the wheel.

The Counter-shaft has tight and loose pulleys 14" in diameter for 4 1-2" belt, and should run from 395 to 410 revolutions per minute.

Weight of machine ready for shipment, about 7220 lbs.

Net Weight, about 5875 lbs.

Floor Space, 53"x 159".

Dimensions of box in which machine is shipped, 110"x 57" x 60".

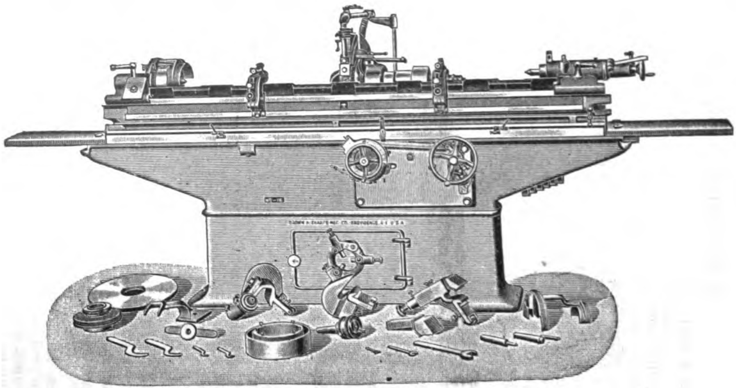
Price includes plain back rest, 2 universal back rests, centre rest, centre grinding attachment, set of dogs, set of telescopic water guards, 1, 18" emery wheel, 1" face, 5" hole; 1, 18" emery wheel, 1 1-2" face, 5" hole; wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Attachments, see pages 120 to 122.

No. 16 10 in. x 72 in.
PLAIN GRINDING MACHINE.

Patented Aug. 12, 1890; May 26, 1891; Sept. 21, Oct. 5, 1897; Nov. 8, 1898; June 6, 1899; June 30, 1903.



This machine will grind work to 10″ in diameter, either straight or taper to 1 1-2″ per foot and 72″ in length.

No. 16

10 in. x 72 in.

PLAIN GRINDING MACHINE.

With Automatic Feeds.

The Wheel Spindle is hardened, ground and lapped, and runs in self aligning bronze boxes provided with means of compensation for wear. It will take wheels to 18" in diameter and from 3-4" to 1 1-2" face.

The Wheel Slide is adjusted by a hand wheel and dial. The dial is graduated to read to thousandths of an inch on the diameter of the work.

The Automatic Cross Feed sizes the work to within .00025". The simple pressing of a thumb latch regulates the feed; the mechanism doing the sizing correctly.

The Swivel Table turns on a large central stud, which is hardened and ground. It can be set at an angle to the ways. This adjustment is made by means of a screw at the end of the table; and a scale, graduated to read to 1 1-2" taper per foot either side of the centre line, indicates the adjustment.

The Travel of Table is automatic in either direction, and controlled by dogs, which are easily adjusted, operating against a sliding pin on the reversing lever.

The Head-stock is clamped to the swivel table.

The Foot-stock is clamped to the swivel table. The spindle is adequately protected from water and emery grit. It can be operated by a lever or hand wheel as desired.

Wet Grinding is amply provided for. Provision is made for a liberal supply of water; the supply pipes are large. Water guards, channels and pans protect the floor and return the waste water to the settling tank and pump. The wheel guard is heavy and of such form as to catch the spray and waste water from the wheel.

The Counter-shaft has tight and loose pulleys 14" in diameter for 4 1-2" belt, and should run from 395 to 410 revolutions per minute.

Weight of machine ready for shipment, about 7990 lbs.

Net Weight, about 6490 lbs.

Dimensions of boxes in which machine is shipped, 114" x 57" x 60", and 135" x 9" x 9".

Floor Space, 53" x 214".

Price includes plain back rest, 2 universal back rests, centre rest, centre grinding attachment, set of dogs, set of telescopic water guards, 1, 18" emery wheel, 1" face, 5" hole; 1, 18" emery wheel, 1 1-2" face. 5" hole; wrenches, etc., together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

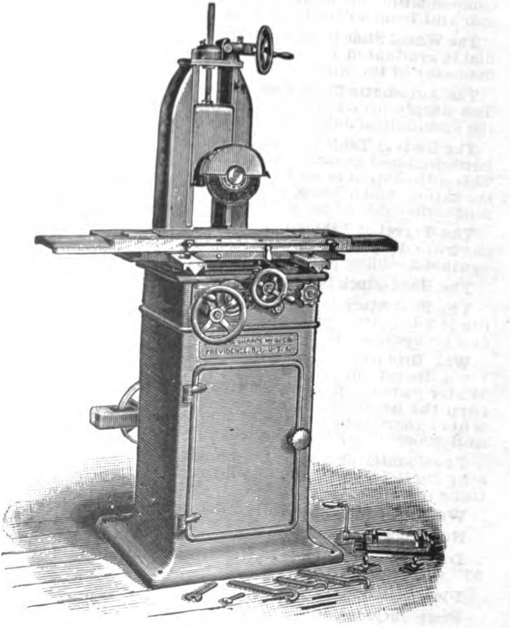
Price, $

For Attachments, see pages 120 to 122.

No. 2

18 in. x 6 in. x 9 1-2 in.

SURFACE GRINDING MACHINE.



The table has an automatic longitudinal feed of 18″, a transverse movement of 6″, and work 9 1-2″ high can be ground.

No. 2

18 in. x 6 in. x 9 1-2 in.

SURFACE GRINDING MACHINE.

The Spindle is hardened, ground and lapped and runs in bronze boxes provided with means of compensation for wear. The end is tapered to receive wheel sleeves. It can be raised or lowered by means of a hand wheel graduated to read to one-half thousandths of an inch. It will take wheels to 7″ in diameter and 1-2″ face.

The Table is 46″ long and 8″ wide, has a working surface 18″x 6″ and 3 T slots 1-2″ wide.

The Travel of Table is automatic in either direction and is controlled by means of dogs operating against a reversing lever. The lever can be turned down and the table moved beyond the reversing points without changing the dogs.

The Transverse Movement of table is automatic, feeds at the end of each stroke and can be easily changed to feed in either direction.

This Machine grinds work to 18″ long, 6″ wide and 9 1-2″ high, using a wheel 7″ in diameter.

The Vise is flanged and has jaws 4 1-8″ long, 1 1-16″ deep, and will open 2″.

The Counter-shaft has tight and loose pulleys 8″ in diameter for 3″ belt and should run 360 revolutions per minute.

Weight of machine ready for shipment, about 1685 lbs.

Net Weight, about 1210 lbs.

Floor Space, 65″x 30″.

Dimensions of box in which machine is shipped, 49″x 37″ x 73″.

Price includes No. 1 Flanged Vise, 1, 7″ emery wheel, 1-2″ face, 1 1-4″ hole; wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

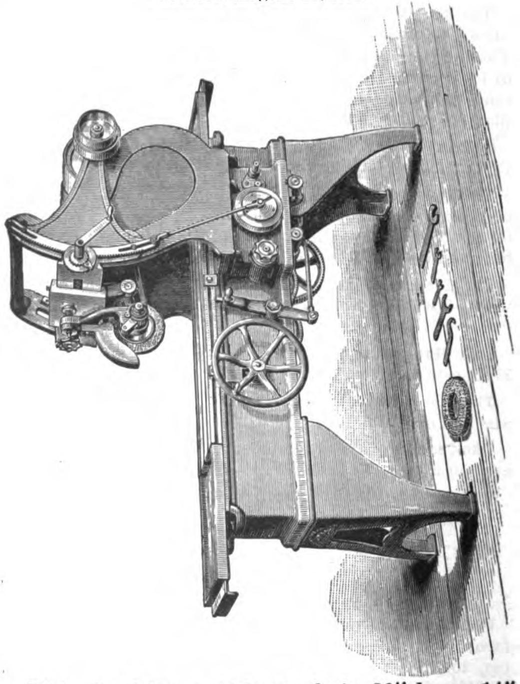
For Adjustable Swivel Vise and Index Centres, see page 77.

No. 3

36 in. x 14 in. x 11 1-2 in. and 60 in. x 14 in. x 11 1-2 in.

SURFACE GRINDING MACHINES.

Patented August 12, 1890.



This machine grinds work to 36″ long, 14″ wide and 11 1-2″ high.

It is also made to grind work 60″ long, 14″ wide and 11 1-2″ high.

No. 3

36 in. x 14 in. x 11 1-2 in. and

60 in. x 14 in. x 11 1-2 in.

SURFACE GRINDING MACHINES.

The Spindle is hardened, ground and lapped and runs in self-aligning bronze boxes provided with means of compensation for wear. It will take wheels to 12" in diameter, and 5-8" face.

The Wheel Slide has a transverse movement that is automatic and can be easily changed to feed in either direction. It feeds at the end of each stroke.

The Table, including dust guards, is 84" long and 14 1-4" wide, has a working surface 44" x 14 1-4" and 3 T slots 11-16" wide.

The Travel of Table is automatic in either direction. It is controlled by means of dogs operating upon a reversing lever trip pin. This pin can be lowered and the table moved beyond the reversing points without changing the dogs.

This machine grinds work to 36" long, 14" wide and 11 1 2" high. Distance between uprights, 22 1-2".

The Counter-shaft has tight and loose pulleys 8" in diameter for 4" belt, and should run about 320 revolutions per minute.

Weight of machine ready for domestic shipment, about 2675 lbs.

Weight of machine ready for foreign shipment, about 3085 lbs.

Net Weight, about 2300 lbs.

Floor Space, 128" x 39".

Dimensions of box in which machine is shipped, 90" x 39" x 56".

Price includes 1, 12" emery wheel, 1-2" face, 5" hole; 1, 9" emery wheel, 5-8" face, 5" hole; and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, $

This machine is also made to grind work to 60" in length.

Weight ready for domestic shipment, about 3180 lbs.

Weight ready for foreign shipment, about 3590 lbs.

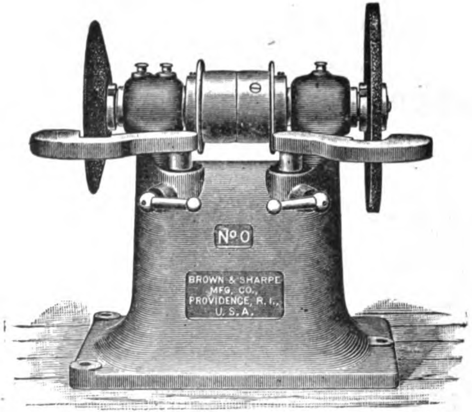
Net Weight, about 2725 lbs.

Floor Space, 192" x 39".

Dimensions of box in which machine is shipped, 103" x 39" x 56".

Price, $

No. 0 TOOL GRINDER.



This machine is especially adapted for grinding the small formed cutters and tools used on screw machines.

The Spindle is hardened and ground and runs in bronze boxes provided with means of compensation for wear. The ends of the spindle are tapered to receive the wheel sleeves. It will take wheels to 7" diameter and 3-8" face. It has tight and loose pulleys, 2 1-2" in diameter for 1" belt.

Distance from centre of spindle to bottom of base, 8 1-2".

Weight of machine ready for shipment, about 50 lbs.

Net Weight, about 35 lbs.

Dimensions of box in which machine is shipped, 16" x 10" x 13".

Price includes two emery wheels, two emery wheel sleeves, wrench and everything else shown in cut, boxed and delivered f. o. b. at Providence, R. I.

Price, $ Price, with overhead works, $

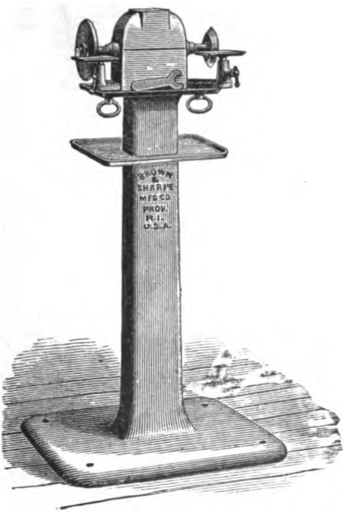
Overhead Works.

The Overhead Works, furnished only when specified, consist of two wall hangers and shaft with 1 pulley 6" diameter, for 2" belt, for main line drive; and 1 pulley 12" diameter for driving the machine spindle. The counter-shaft should run about 460 revolutions per minute.

Weight for shipment, about 100 lbs.

Net Weight, about 80 lbs. Price, $

No. 1 TOOL GRINDING MACHINE.



The Spindle is of steel hardened and ground, and runs in bronze boxes provided with means of compensation for wear. The ends of the spindle are tapered to receive wheel sleeves.

The Counter-shaft has tight and loose pulleys 6" in diameter for 2" belt, and should run about 375 rev. per minute.

Weight of machine ready for domestic shipment, about 215 lbs.; for foreign shipment, about 415 lbs.

Net Weight, about 280 lbs.

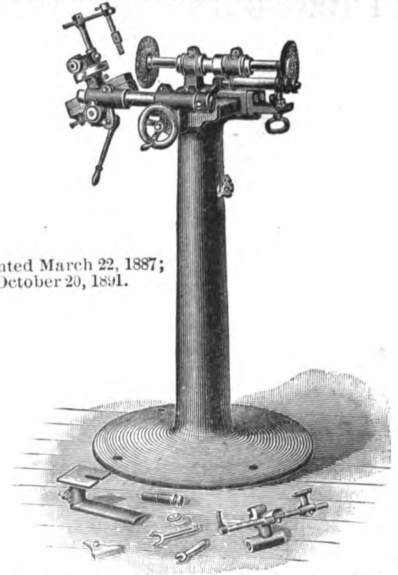
Floor Space, 16"x 18".

Dimensions of box for shipment, 52"x 21"x 21".

Price includes two emery wheels, two wheel sleeves, 1 1-4", rests and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

No. 2 CUTTER GRINDING MACHINE.



Patented March 22, 1887;
October 20, 1891.

This machine will take cutters to 6″ in length and 6″ in diameter, and saws to 24″ diameter.

The Spindle is hardened, ground and lapped, and runs in bronze boxes provided with means of compensation for wear. The ends of Spindle are tapered to receive Wheel Sleeves.

The Cone has 2 steps for 1″ belt.

The Cutter Bar is of steel hardened and ground.

The Counter-shaft has tight and loose pulleys 6″ in diameter for 2″ belt, and should run about 375 rev. per minute.

Weight of machine ready for shipment, about 585 lbs.

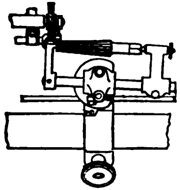
Net Weight, about 380 lbs. Floor Space, 27″ x 34″.

Dimensions of box for shipment, 36″ x 29″ x 51″.

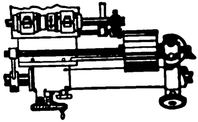
Price includes Compound Swivel Head, Rest Holder, 3-4″ Cutter Bar, 7-8″ Cutter Shell with collars and nut, Arbor for holding Straddle and Face Mills, etc., 2 Taper Shank Mill Bushings; 2, 1 1-4″ Wheel Sleeves; 1 pair Step Collars, 1 1-2″, 1 3-4″, 2″; 2, 6″ Bevel and Concave Emery Wheels, 1 1-4″ hole; 1, 6″ Emery Wheel, 1-4″ face, 1 1-4″ hole, and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I. Price, $

For Formed Cutter Grinding Attachment, see page 118.

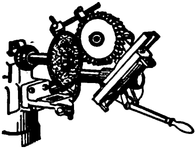
VARIOUS OPERATIONS ON THE No. 3 UNIVERSAL CUTTER AND REAMER GRINDER.



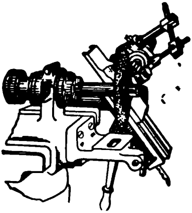
Grinding Solid Taper Reamer.



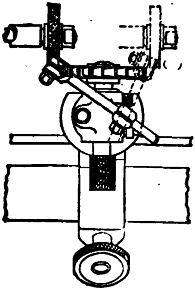
Grinding Milling Cutter or Shell Reamer.



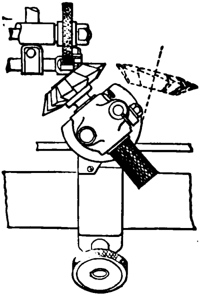
Grinding Side Milling Cutter.



Grinding End Mill.



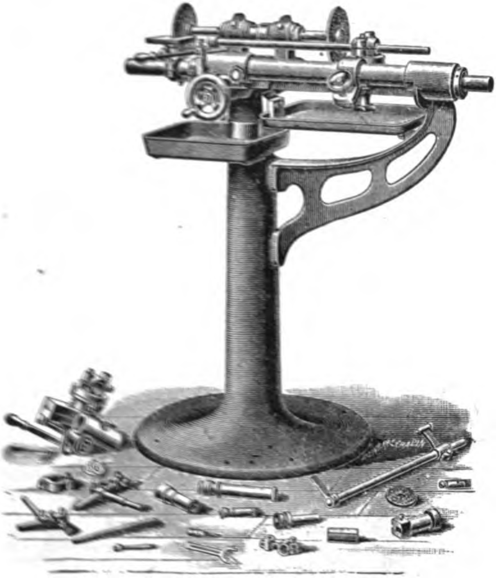
Grinding Side of Face Mill.



Grinding Angular Cutter.

No. 3 UNIVERSAL CUTTER AND REAMER GRINDER.

Patented March 22, 1887; Oct. 29, 1891.



This machine takes 18″ between centres, and takes cutters and shell reamers not exceeding 6″ in diameter and 7″ in length.

No. 3 UNIVERSAL CUTTER AND REAMER GRINDER.

This machine is used for sharpening straight and taper, shell or shank reamers, and for grinding edge and bevel cutters of any angle, straddle and face mills, cotter and hollow mills and straight or taper milling cutters, cut either straight or spiral, with holes or shanks. It can also be used for sharpening worm and thread tools.

The Spindle is of steel, hardened, ground, and lapped, and runs in bronze boxes provided with means of compensation for wear. The ends of the Spindle are tapered to receive Wheel Sleeves.

The Cone has 2 steps for 1" belt.

The Guide Bar and Cutter **Bars are** of steel **hardened**, ground and lapped.

The Counter-shaft has tight and loose pulleys 6" in diameter for 2" belt and should run about 375 revolutions per minute.

Weight of machine ready for shipment, about 750 lbs.

Net Weight, about 490 lbs.

Floor Space, 33"x 58".

Dimensions of box in which machine is shipped, 42"x 30"x 52".

Price includes Compound Swivel Head, Reamer Centres, Rest Holder, 3-4" Cutter Bar, 3-8" Cutter Bar, Thread and Worm Tool Holder, 7-8" Cutter Shell with collars and nut, takes all cutters with 7-8", 1", 1 1-16", 1 1-8" or 1 1-4" hole; 1-2" Cutter Shell with collars and nut, takes all cutters with 1-2", 5-8", or 3-4" hole; Arbor for holding Straddle and Face Mills; Angular Cutters, etc., takes all cutters with 1 1-4", 1" or 7-8" hole; 2 Wheel Sleeves 1 1-4", 2 Taper Shank Mill Bushings, 2 Main Bar Stops; 3-4" Swivel Head Bushing, 3-8" Swivel Head Bushing; 1 pair Step Collars, 1 1-2", 1 3-4", 2"; 2, 6" Bevel and Concave Emery Wheels, 3-8" face, 1 1-4" hole; 1, 6" Emery Wheel, 1-4" face, 1 1-4" hole; 1, 3" Emery Wheel, 1-4" face, 3-4" hole; 1, 2" Emery Wheel, 1-4" face, 1-4" hole; and everything else shown in the cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, $

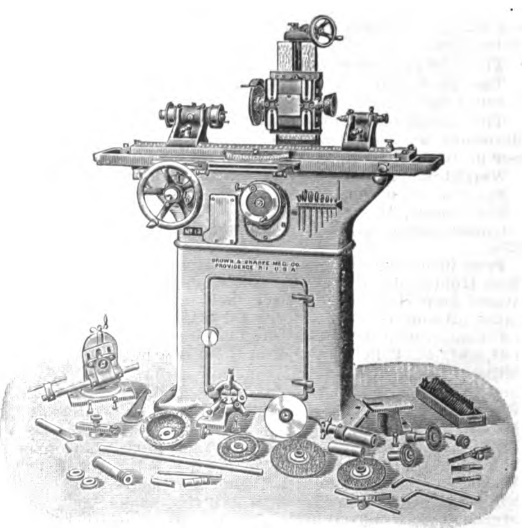
The Formed Cutter Grinding Attachment is readily attached to the machine, and can be used equally well with either a machine of the old or new design. See page 118.

Price, $

A special pamphlet on the construction and use of this machine is sent on application.

No. 13
UNIVERSAL AND TOOL GRINDING MACHINE.

Patented March 25, 1902.



This machine takes 24 1-2″ in length between centres and centres swing 8″ in diameter.

No. 13 UNIVERSAL AND TOOL GRINDING MACHINE.

With Power Table Feed.

This machine combines the features of a Universal Grinding Machine, together with such features as adapt it to the sharpening of bevel cutters of any angle, milling cutters, formed cutters, straddle and face mills, straight or taper reamers, end mills etc., also for grinding all cylindrical work, either straight or taper, that can be held between centres.

The Wheel Spindle is hardened, ground and lapped and runs in phosphor bronze boxes, provided with means of compensation for wear. The ends of the spindle are tapered to receive wheel sleeves.

The Wheel Slide has a vertical adjustment of 6", operated by a hand wheel graduated to read to thousandths of an inch.

The Upright that carries the spindle head swivels and has a graduated base. It has a transverse movement of 10 1-2", operated by a hand wheel, graduated to read to thousandths of an inch on the diameter of the work.

The Cutter Bars are hardened, ground and lapped.

The Swivel Table turns on a central stud. It can be set to 45° either side of centre line, the graduated arc at the front reading to degrees. A scale at the end of table is graduated to read to 3" taper per foot.

The Table has a longitudinal feed of 17".

The Head and Foot-stock Centres swing 8" in diameter and take 24 1-2" in length.

The Counter-shaft has tight and loose pulleys 6" in diameter for 2 1-2" belt and should run 425 revolutions per minute.

Weight of machine ready for shipment, about 2735 lbs.

Net Weight, about 2170 lbs. Floor Space, 45"x 69".

Dimensions of box for shipment, 56"x 45"x 66".

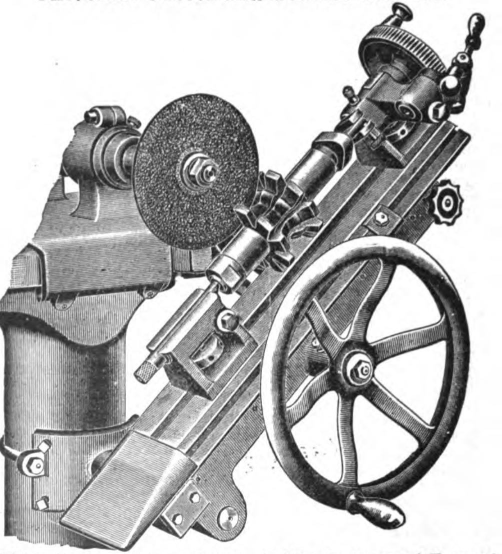
Price includes universal head, face chuck, set of dogs, centre height gauge; 3-4" cutter bar with 7-8" sliding shell and set of collars, including 4 stepped collars; 3-8" cutter bar with bushing for universal head and 1-2" sliding shell, with set of collars, including 2 stepped collars; arbor for straddle and face mills and 3 collars, 2 taper shank mill bushings, 4 tooth rests and holders; 4 centres, including reamer grinding centre, centre rest, tool rest; wheel arbors; 1, 1-4" R. H.; 1, 1-4" L. H.; 1, 1-2"; 1, 3-4" 6 wheel sleeves; 1, 1" emery wheel, 1-4" face; 1, 2" emery wheel, 1-4" face; 1, 4" cupped emery wheel, 1 3-8" thick; 1, 7" cupped emery wheel, 2" thick; 1, 3" emery wheel, 1-4" face, 2, 7" emery wheels, 1-2" face; 1, 6" emery wheel, 3-8" face; 1, 3 1-2" bevel and concave emery wheel; 1, 6" bevel and concave emery wheel; and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, with Power Table Feed, $

For Attachments, see page 119.

FORMED CUTTER GRINDING ATTACHMENT

For No. 2 Cutter Grinding Machine and No. 3 Universal Cutter and Reamer Grinder.



This attachment is used for grinding the teeth of Formed Cutters *radially*, this being necessary in order to insure their cutting the correct form. It consists of a bed rigidly attached to the main bar, that carries a sliding table provided with a pair of index centres between which the work to be ground is held.

Centres swing 4 3-4″ in diameter and take 10 1-2″ in length.

The Index Plate has 24 holes and can be turned by a worm or the worm can be disengaged and the plate turned by hand.

Formed Cutters to 8″ in diameter can be ground by the use of raising blocks.

Net Weight, about 70 lbs. Weight for shipment, about 100 lbs.

Dimensions of box for shipment, 20″x 13″x 12″.

Price, $

For No. 2 Cutter Grinding Machine and No. 3 Universal Cutter and Reamer Grinder, see pages 112, 114, 115.

ATTACHMENTS
FOR
No. 13 UNIVERSAL AND TOOL GRINDING MACHINE.

SURFACE GRINDING ATTACHMENT.

The Wheel Spindle Extension is bolted to the wheel slide and supported in self-aligning bearings. It allows the wheel to be used over the entire surface of the Table Plate.

The Table Plate has a working surface of 17"x 7 3-8" and is 1 1-2" thick. It has 2 T slots, 1-2" wide, at right angles.

The Vise is mounted upon a hinged base that can be set to any angle from 0 to 90° in a vertical plane. A dial, graduated to degrees, indicates the setting. The jaws are hardened, 3 5-8" wide, 15-16" deep and will open 1 1-2". Height of vise, 4". **Price**, Attachment complete, $

INTERNAL GRINDING ATTACHMENT.

This Attachment is driven by a belt from a pulley on the wheel spindle.

Distance from centre of spindle of attachment to centre of wheel spindle, 10". Length that can be ground, 3". Diameter of hole that can be ground, 1-4" to 1 1-2".

Price includes 3 emery wheels, 3 extension wheel arbors, 4" 3-jawed universal chuck, belt and driving pulley.

Price, $

CIRCULAR GRINDING ATTACHMENT.

The Slide swivels and has adjustable stops to control the swivel movement. It has an adjustment of 4 1-2"; also a fine adjustment for feeding the work to the cut. A device for receiving the carbon point holder, furnished, can be quickly mounted on the inner end of the slide for truing the wheel.

The Work Holders will take 5" in length and swing 8" in diameter. **Price**, $

TOOL CUPBOARD
TO ACCOMPANY
No. 13 Universal and Tool Grinding Machine.

A Cupboard for holding the various parts and attachments that go with this machine, can be furnished. It is substantially made and fitted with shelves and brackets conveniently arranged.

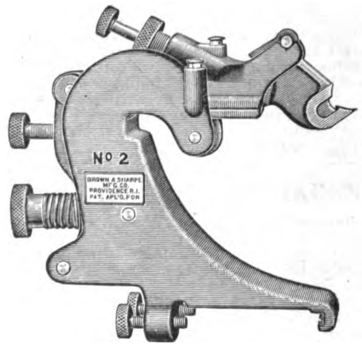
Dimensions, height, 39"; floor space, 16"x 38".

Price, $

UNIVERSAL BACK RESTS.

For Universal and Plain Grinding Machines.

Patent Applied for.



The Back Rests are universal in all their movements and capable of the most delicate adjustment. They are simple in construction and readily placed in position or removed.

No.	Machines where used.	Price.
1	No. 1 Universal	$8 00
2	Nos. 2, 3 and 4 Universal	9 00
11	No. 11 Plain	8 00
14	Nos. 14 and 16 Plain	9 00

For Lists of Shoes, see pages 121 and 122.

Special Circular on application.

WATER GUARDS.

For Universal Grinding Machines.

These can be used on all Nos. 1 and 2 Universal Grinding Machines fitted with pumps; and all Nos. 3 and 4 Universal Grinding Machines delivered since January, 1899.

PRICE PER SET.

For No. 1	Universal Grinding Machine,	$5 50
For No. 2	Universal Grinding Machine,	$6 00
For No. 3	Universal Grinding Machine,	$7 00
For No. 4	Universal Grinding Machine,	$8 00

BRONZE SHOES

FOR UNIVERSAL BACK RESTS.

For Nos. 1 and 11.

Pattern No.	Diameter of Work.	Price each.	Pattern No.	Diameter of Work.	Price each.
1 — 3	1-4″	22 cts.	1 — 13	1 1-2″	22 cts.
1 — 3	5-16	22	1 — 13	1 9-16	22
1 — 4	3-8	22	1 — 14	1 5-8	22
1 — 4	7-16	22	1 — 14	1 11-16	22
1 — 5	1-2	22	1 — 15	1 3-4	28
1 — 6	5-8	22	1 — 15	1 13-16	28
1 — 6	11-16	22	1 — 16	1 7-8	28
1 — 7	3-4	22	1 — 16	1 15-16	28
1 — 7	13-16	22	1 — 17	2	28
1 — 8	7-8	22	1 — 17	2 1-16	28
1 — 8	15-16	22	1 — 18	2 1-8	28
1 — 9	1	22	1 — 18	2 3-16	28
1 — 9	1 1-16	22	1 — 19	2 1-4	28
1 — 10	1 1-8	22	1 — 19	2 5-16	28
1 — 10	1 3-16	22	1 — 20	2 3-8	28
1 — 11	1 1-4	22	1 — 20	2 7-16	28
1 — 11	1 5-16	22	1 — 21	2 1-2	28
1 — 12	1 3-8	22	1 — 21	2 9-16	28
1 — 12	1 7-16	22			

Special Circular on Application.

List continued on next page.

BRONZE SHOES
FOR UNIVERSAL BACK RESTS.
Nos. 2 and 14.

Pattern No.	Diameter of Work.	Price each.	Pattern No.	Diameter of Work.	Price each.
2 — 5	5-8"	28 cts.	2 — 21	2 11-16"	50 cts.
2 — 5	11-16	28	2 — 22	2 3-4	50
2 — 6	3-4	28	2 — 22	2 13-16	50
2 — 6	13-16	28	2 — 23	2 7-8	50
2 — 7	7-8	28	2 — 23	2 15-16	50
2 — 7	15-16	28	2 — 24	3	50
2 — 8	1	28	2 — 24	3 1-16	50
2 — 8	1 1-16	28	2 — 25	3 1-8	72
2 — 9	1 1-8	28	2 — 25	3 3-16	72
2 — 9	1 3-16	28	2 — 26	3 1-4	72
2 — 10	1 1-4	28	2 — 26	3 5-16	72
2 — 10	1 5-16	28	2 — 27	3 3-8	72
2 — 11	1 3-8	28	2 — 27	3 7-16	72
2 — 11	1 7-16	28	2 — 28	3 1-2	72
2 — 12	1 1-2	28	2 — 28	3 9-16	72
2 — 12	1 9-16	28	2 — 29	3 5-8	72
2 — 13	1 5-8	28	2 — 29	3 11-16	72
2 — 13	1 11-16	28	2 — 30	3 3-4	72
2 — 14	1 3-4	50	2 — 30	3 13-16	72
2 — 14	1 13-16	50	2 — 31	3 7-8	72
2 — 15	1 7-8	50	2 — 31	3 15-16	72
2 — 15	1 15-16	50	2 — 32	4	72
2 — 16	2	50	2 — 32	4 1-16	72
2 — 16	2 1-16	50	2 — 32	4 1-8	72
2 — 17	2 1-8	50	2 — 33	4 1-4	90
2 — 17	2 3-16	50	2 — 34	4 1-2	90
2 — 18	2 1-4	50	2 — 35	4 3-4	90
2 — 18	2 5-16	50	2 — 36	5	90
2 — 19	2 3-8	50	2 — 37	5 1-4	90
2 — 19	2 7-16	50	2 — 38	5 1-2	90
2 — 20	2 1-2	50	2 — 39	5 3-4	90
2 — 20	2 9-16	50	2 — 40	6	90
2 — 21	2 5-8	50			

Special Circular on Application.

In ordering Bronze Shoes, give pattern number and diameter of work to be ground.

For example:

If shoe is wanted for either the Nos. 2 or 14 Universal Back Rests to grind work to 11-16" in diameter, the order should read: 1 bronze shoe, No. 2 — 5, 11-16".

DIMENSIONS OF AUTOMATIC GEAR CUTTING MACHINES.

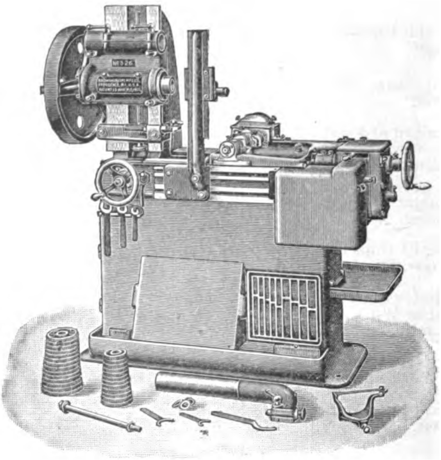
No. of Machine.	3	4	5	6	13
Will cut, Diameter.	26" & 36"	36" & 48"	48" & 60"	60" & 72"	18"
Will cut, Face.	8"	9"	10"	12"	4"
Will cut, Diametral Pitch.	5	4	3	2	5
Will cut, Circular Pitch	5-8"	3-4"	1"	1 1-2"	5-8"
No. of Changes of Feed.	3 1-2"	4 1-2"	5"	7"	3"
Variation of Feed per Revolution of Cutter.	.015" to .147"	.019" to .263"	.037" to .620"	.050" to .373"	.012" to .235"
Diameter of Index Wheel.	19"	25 1-2"	34"	43 1-2"	19"
Diam. of Cutter Arbor.	1"	1 1-4"	1 1-2"	1 3-4"	7-8"
Diameter of front end of Work Spindle.	3"	4"	5"	6"	3"
No. of Taper Hole in Work Spindle.	12	14	16	18	12
Speed of Counter-shaft.	380	306	300	223	350
Floor Space.	64"x 40"	85" x 40"	100"x 56"	114"x 66"	63"x 43"
Net Weight, about.	2310 lbs.	3850 lbs.	5925 lbs.	9400 lbs.	2650 lbs.
Price.					
Price, with Pump.					

No. 3

26 in. x 8 in. and 36 in. x 8 in.

AUTOMATIC GEAR CUTTING MACHINES.

Patented March 13, 1900.



This machine cuts spur gears to 26″ in diameter, 8″ face and 5 diametral pitch.

It is also made to cut spur gears to 36″ in diameter, 8″ face and 5 diametral pitch.

No. 3

26 in. x 8 in. and 36 in. x 8 in.

AUTOMATIC GEAR CUTTING MACHINES.

The Cutter Spindle has 8 changes of speed, varying from 28 to 168 revolutions per minute. An outer bearing on the cutter slide gives additional support to the cutter arbor.

The Cutter Arbor furnished is 1" in diameter.

12 Changes of feed of cutter, evenly graded from .015" to .147" per revolution, can be obtained by means of change gears. The return of cutter slide is rapid.

The Head, which carries the work spindle, is adjusted by means of a screw operated by a hand wheel. A dial graduated to read to thousandths of an inch indicates this adjustment. The work spindle has a No. 12 taper hole.

The Overhanging Arm clears gears to 12" in diameter.

An Outer Support for end of work arbor is furnished and takes all work to full capacity of machine. It has a hole for outer bearing as well as an adjustable centre.

The Indexing Mechanism is independent of the feed and speed of cutter, so that the indexing is as rapid when these are slow as when they are fast. It operates without shock.

The Index Change Gears provide for cutting all numbers of teeth from 12 to 50, and all numbers from 50 to 400, excepting the prime numbers and their multiples.

Tables giving cutter speeds, the changes for gears to use for cutting the various numbers of teeth and the changes for feed gears to obtain the proper feed for the cutter slide, are sent with each machine.

The Counter-shaft has tight and loose pulleys, 10" in diameter for 3 1-2" belt and should run about 260 revolutions per minute.

Weight of machine ready for shipment, about 3100 lbs.

Net Weight, about 2400 lbs. **Floor Space,** 64"x 40".

Dimensions of box for shipment, 65" x 35"x 66".

Price includes indicator for setting cutter, change gears, outer support for work arbor, wrenches etc., together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $** **Price,** machine with pump, **$

This Machine is also made to cut SPUR GEARS to 36" diameter, 8" face and 5 diametral pitch.

Weight of machine ready for shipment, about 3190 lbs.

Net Weight, about 2485 lbs. **Floor Space,** 64"x 40".

Dimensions of box for shipment, 65"x 35"x 66".

Price, $** **Price,** machine with pump, **$

For Arbors, Bushings, Collets, sets of same and Attachments, see pages 134 to 138.

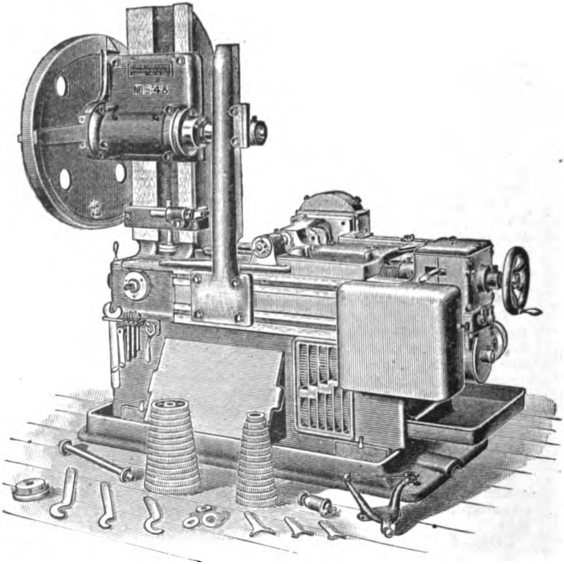
For Cutters to use with this machine, see pages 266 and 273.

No. 4

36 in. x 9 in. and 48 in. x 9 in.

AUTOMATIC GEAR CUTTING MACHINES.

Patented March 13, 1900



This machine cuts spur gears to 36″ in diameter, 9″ face and 4 diametral pitch.

It is also made to cut spur gears to 48″ in diameter, 9″ face and 4 diametral pitch.

No. 4

36 in. x 9 in. and 48 in. x 9 in.

AUTOMATIC GEAR CUTTING MACHINES.

The Cutter Spindle has 6 changes of speed, varying from 20 to 106 revolutions per minute. An outer bearing on the cutter slide gives additional support to the cutter arbor.

The Cutter Arbor furnished is 1 1-4" in diameter. It can be removed and other smaller sizes substituted. Other sizes carried in stock.

12 Changes of feed of cutter, evenly graded from .019" to .263" per revolution, can be obtained by means of change gears. The return of cutter slide is rapid.

The Head, which carries the work spindle, is adjusted by means of a screw operated by a hand wheel. A dial graduated to read to thousandths of an inch indicates this adjustment. The work spindle has a No. 14 taper hole.

An Outer Support for end of work arbor is furnished and takes all work to full capacity of machine. It has a hole for outer bearings as well as an adjustable centre.

The Indexing Mechanism is independent of the feed and speed of cutter, so that the indexing is as rapid when these are slow as when they are fast. It operates without shock.

The Index Change Gears provide for cutting all numbers of teeth from 12 to 50 and all numbers from 50 to 400, excepting the prime numbers and their multiples.

Tables giving cutter speeds, the changes for gears to use for cutting the various numbers of teeth and the changes for feed gears to obtain the proper feed for the cutter slide, are sent with each machine.

The Counter-shaft has tight and loose pulleys, 14" in diameter for 4 1-2" belt and should run about 250 revolutions per minute.

Weight of machine ready for shipment, about 4790 lbs.
Net Weight, about 3820 lbs. **Floor Space**, 85" x 40".
Dimensions of box for shipment, 77" x 44" x 71".

Price includes indicator for setting cutter, change gears, 2 1-2" expansion bushing, wrenches etc., together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $ Price, machine with pump, $

This Machine is also made to cut SPUR GEARS to 48" diameter, 9" face, and 4 diametral pitch.
Weight of machine ready for shipment, about 4800 lbs.
Net Weight, about 3925 lbs.
Floor Space, 85" x 40".
Dimensions of box for shipment, 77" x 44" x 78".
Price, $ Price, machine with pump, $

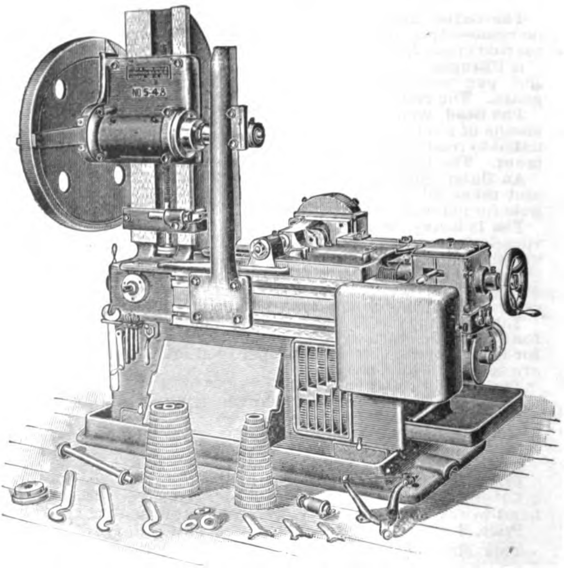
For Arbors, Bushings, Collets, sets of same, and Attachments, see pages 134 to 138.
For Cutters to use with this machine, see pages 266 and 273.

No. 5

48 in. x 10 in. and 60 in. x 10 in.

AUTOMATIC GEAR CUTTING MACHINES.

Patented July 13, 1897; March 13, 1900.



This machine cuts spur gears to 48″ in diameter, 10″ face and 3 diametral pitch.

It is also made to cut spur gears to 60″ in diameter, 10″ face and 3 diametral pitch.

No. 5

48 in. x 10 in. and 60 in. x 10 in.

AUTOMATIC GEAR CUTTING MACHINES.

The Cutter Spindle has 6 changes of speed, varying from 20 to 80 revolutions per minute. An outer bearing on the cutter slide gives additional support to the cutter arbor.

The Cutter Arbor furnished is 1 1-2" in diameter. It can be removed and other smaller sizes substituted Other sizes carried in stock.

15 Changes of feed of cutter, evenly graded from .037" to .620" per revolution, can be obtained by means of change gears. The return of cutter is rapid.

The Head, which carries the work spindle, is adjusted by means of a screw operated by a crank. A dial, graduated to read to thousandths of an inch, indicates this adjustment. The work spindle has a No. 16 taper hole. Provision is made for raising and lowering the head by power.

An Outer Support for end of work arbor is placed on the machine, and takes all work to full capacity of machine.

The Indexing Mechanism is independent of the feed and speed of cutter so that the indexing is as rapid when these are slow as when they are fast. It operates without shock.

The Index Change Gears provide for cutting all numbers of teeth from 12 to 50, and all numbers from 50 to 400, excepting the prime numbers and their multiples.

A Withdrawing Expansion Arbor is furnished with the machine and allows the work to be placed in position and removed without disturbing the adjustments.

Tables giving cutter speeds, the changes for gears to use for cutting the various numbers of teeth and the changes for feed gears to obtain the proper feed for the cutter slide, are sent with each machine.

The Counter-shaft has tight and loose pulleys, 18" in diameter for 5" belt, and should run about 300 revolutions per minute.

Weight of machine ready for shipment, about 7075 lbs.

Net Weight, about 5905 lbs. **Floor Space,** 100" x 56".

Dimensions of box for shipment, 87"x 51"x 80".

Price includes indicator for setting cutter, change gears, 3" expansion bushing, wrenches, etc., together with overhead works, boxed and delivered f. o b. at Providence, R. I

Price, $ **Price,** machine with pump, $

This Machine is also made to cut SPUR GEARS to 60" diameter, 10" face, and 3 diametral pitch.

Weight of machine ready for shipment, about 7275 lbs.

Net Weight, about 6080 lbs. **Floor Space,** 100"x 56".

Dimensions of box for shipment, 87"x 51"x 86".

Price, $ **Price,** machine with pump, $

For Arbors, Bushings, Collets, sets of same, and Internal Gear Cutting Attachment, see pages 134 to 137.

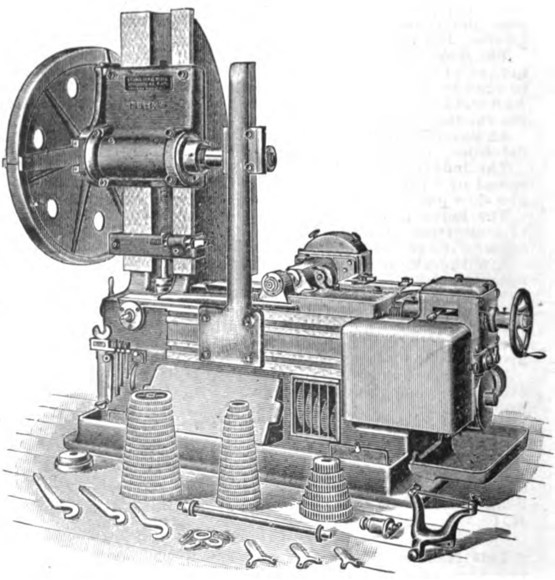
For Cutters to use with this machine, see pages 266 and 274.

No. 6

60 in. x 12 in. and 72 in. x 12 in.

AUTOMATIC GEAR CUTTING MACHINES.

Patented July 13, 1897; March 13, 1900.



This machine cuts spur gears to 60″ in diameter, 12″ face and 2 diametral pitch.

It is also made to cut spur gears to 72″ in diameter, 12″ face and 2 diametral pitch.

No. 6

60 in. x 12 in. and 72 in. x 12 in.

AUTOMATIC GEAR CUTTING MACHINES.

The Cutter Spindle has 6 changes of speed, varying from 12 to 50 revolutions per minute. An outer bearing on the cutter slide gives additional support to the cutter arbor.

The Cutter Arbor furnished is 1 3-4" in diameter. It can be removed and other smaller sizes substituted. Other sizes carried in stock.

12 Changes of feed of cutter, evenly graded from .050" to .373" per revolution, can be obtained by means of change gears. The return of cutter slide is rapid.

The Head, which carries the work spindle, is adjusted by means of a screw operated by a crank. A dial, graduated to read to thousandths of an inch, indicates this adjustment. The work spindle has a No. 18 taper hole. Provision is made for raising and lowering the head by power.

An Outer Support for end of work arbor is furnished and takes all work to full capacity of machine. It has a hole for outer bearing as well as an adjustable centre.

The Indexing Mechanism is independent of the feed and speed of cutter, so that the indexing is as rapid when these are slow as when they are fast. It operates without shock.

The Index Change Gears provide for cutting all numbers of teeth from 12 to 50 and all numbers from 50 to 400, excepting the prime numbers and their multiples.

A Withdrawing Expansion Arbor is furnished with the machine and allows the work to be placed in position and removed without disturbing the adjustments.

Tables giving cutter speeds, the changes for gears to use for cutting the various numbers of teeth and the changes for feed gears to obtain the proper feed for the cutter slide, are sent with each machine.

The Counter-shaft has tight and loose pulleys, 24" in diameter for 7' belt, and should run about 223 revolutions per minute.

Weight of machine ready for shipment, about 11420 lbs.
Net Weight, about 9400 lbs. **Floor Space**, 114"x 66".
Dimensions of box for shipment, 100"x 64"x 93".
Price includes indicator for setting cutter, change gears, 4" expansion bushing, wrenches etc., together with overhead works, boxed and delivered f. o. b. at Providence, R. I.
Price, $ **Price**, machine with pump, **$**

This Machine is also made to cut SPUR GEARS to 72" diameter, 12" face and 2 diametral pitch.

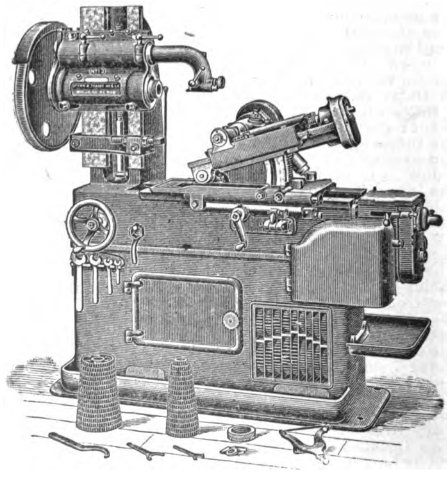
Weight of machine ready for shipment, about 11450 lbs.
Net Weight, about 9650 lbs. **Floor Space**, 114"x 66".
Dimensions of box for shipment, 100"x 64"x 99".
Price, $ **Price**, machine with pump, **$**

For Arbors, Bushings, Collets, sets of same, and Internal Gear Cutting Attachment, see pages 134 to 137.
For Cutters to use with this machine, see pages 267 and 274.

No. 13

18 in. x 4 in.

AUTOMATIC GEAR CUTTING MACHINE.



This machine cuts spur and bevel gears to 18″ in diameter, 4″ face and 5 diametral pitch.

No. 13

18 in. x 4 in.

AUTOMATIC GEAR CUTTING MACHINE

For Spur and Bevel Gears.

Patented Feb. 6, Mar. 13, 1900.

The Cutter Spindle, 7-8" diameter, has 10 changes of speed, obtained by means of change gears, evenly graded from 30 to 163 revolutions per minute. An outer bearing on the cutter slide gives additional support to the cutter spindle. Bushings furnished to take cutters with 1 1-4" hole.

The Cutter Slide is adjustable to any angle to 90 degrees. A graduated arc indicates the angle of elevation. The cutter can be set either side of the centre when cutting bevel gears. A vernier graduated to read to thousandths of an inch indicates the adjustment.

16 Changes of feed of cutter, evenly graded from .012" to .235" per revolution of spindle, can be obtained by means of change gears. The return of cutter is rapid.

The Head, which carries the work spindle, is adjusted by means of a screw operated by a hand wheel. The thrust of the elevating screw is taken by ball bearings. A dial, graduated to read to thousandths of an inch, indicates the adjustment.

The work spindle has a No. 12 taper hole, 1 1-2" diameter at small end.

The Overhanging Arm clears gears to 12" in diameter. Larger gears are supported by a rest placed back of the rim of gear, opposite cutter.

The Indexing Mechanism is independent of the feed and speed of cutter, so that the indexing is as rapid when these are slow as when they are fast. It operates without shock.

The Index Change Gears provide for cutting all numbers of teeth from 12 to 50, and all numbers from 50 to 400, except the prime numbers and their multiples.

Tables giving cutter speeds, the changes for gears to use for cutting the various numbers of teeth and the changes for feed gears to obtain the proper feed for the cutter slide, are sent with each machine.

The Counter-shaft has tight and loose pulleys 10" in diameter for 3" belt, and should run about 350 revolutions per minute.

Weight of machine ready for shipment, about 3350 lbs.

Net Weight, about 2675 lbs.

Floor Space, 63" x 43".

Dimensions of box in which machine is shipped, 67"x 39" x 64".

Price, $ **Price**, machine with pump, $

For Arbors, Bushings, Collets and sets of same, see pages 134 to 136.

EXPANSION BUSHINGS FOR WORK ARBORS.

Automatic Gear Cutting Machines.

Outside Diameter	Machine where used.	Length.	Number of Taper Hole.	Used with Arbor.	Price.
3-4"	Nos. 3 and 13	3"	6	I	$1 00
7-8	"	"	"	"	1 00
1	"	"	"	"	1 00
1 1-8	"	"	"	"	1 00
1 1-4	"	3 1-2	9	J	1 30
1 3-8	"	"	"	"	1 55
1 1-2	"	"	"	"	1 55
1 5-8	"	"	"	"	1 90
1 3-4	"	"	11	K	1 90
2	"	"	"	"	2 20
2 1-4	"	"	"	"	2 20
1	No. 4	3 1-2	7	M	1 05
1 1-8	"	"	"	"	1 05
1 1-4	"	"	"	"	1 30
1 3-8	"	"	"	"	1 55
1 1-2	"	5	10	N	1 55
1 5-8	"	"	"	"	1 90
1 3-4	"	"	"	"	1 90
2	"	"	"	"	2 20
*2	"	"	12	O	2 20
*2 1-4	"	"	"	"	2 20
†*2 1-2	"	"	"	"	2 65
*2 3-4	"	"	"	"	3 10
*3	"	"	"	"	3 50
1 1-2	No. 5	4 1-2	10	Q	1 55
1 5-8	"	"	"	"	1 90
1 3-4	"	"	"	"	1 90
2	"	"	"	"	2 20
2 1-4	"	"	"	"	2 20
*2 1-2	"	6	13	R	2 65
*2 3-4	"	"	"	"	3 10
†*3	"	"	"	"	3 50
*3 1-4	"	"	"	"	3 50
3 1-4	"	"	14	S	3 50
*3 1-2	"	"	13	R	3 60
3 1-2	"	"	14	S	3 60
2 1-4	No. 6	6	12	U	2 20
2 1-2	"	"	"	"	2 65
2 3-4	"	"	"	"	3 10

In ordering, state outside diameter, and letter of Arbor.
Bushings marked * can be used on Withdrawing Work Arbors furnished.
Bushings marked † are furnished with the machine.

EXPANSION BUSHINGS FOR WORK ARBORS—Continued.

Outside Diameter.	Machine where used.	Length.	Number of Taper Hole.	Used with Arbor.	Price.
*3"	No. 6	7 1-2"	14	V	$3 65
*3 1-4	"	"	"	"	3 80
*3 1-2	"	"	"	"	4 00
*3 3-4	"	"	"	"	4 15
†*4	"	"	"	"	4 30
4	"	9	18	W	4 50
4 1-2	"	"	"	"	5 00
5	"	"	"	"	5 50

In ordering, state outside diameter, and letter of Arbor.
Bushings marked * can be used on Withdrawing Work Arbors.
Bushing marked † is furnished with the machine.

WORK ARBORS.

AUTOMATIC GEAR CUTTING MACHINES.

Mark.	Machine where used.	No. of Taper of Shank.	Length of Bushing.	No. of Taper for Bushing.	Smallest Possible Bushing.	Price.
*I	Nos. 3 and 13	10	3"	6	3-4"	$ 9 00
J	"	12	3 1-2	9	1 1-4	14 00
K	"	12	3 1-2	11	1 3-4	14 00
*M	No. 4	11	3 1-2	7	1	10 00
N	"	14	5	10	1 1-2	16 00
O	"	14	5	12	2	16 00
*Q	No. 5	12	4 1-2	10	1 1-2	14 00
R	"	16	6	13	2 1-2	20 00
S	"	16	6	14	3 1-4	20 00
*U	No. 6	14	6	12	2 1-4	18 00
V	"	18	7 1-2	14	3	22 00
W	"	18	9	18	4	24 00

Arbors marked * are for use in the Collets.

COLLETS FOR WORK SPINDLE.

AUTOMATIC GEAR CUTTING MACHINES.

Mark.	Machine where used.	Outside Taper.	Inside Taper.	Price.
V	Nos. 3 and 13	No. 12	No. 10	$6 50
VV	Nos. 3 and 13	" 12	" 11	6 50
W	No. 4	" 14	" 11	8 00
WW	" 4	" 14	" 10	8 00
X	" 5	" 16	" 12	10 00
XX	" 5	" 16	" 11	10 00
Y	" 6	" 18	" 14	13 00
YY	" 6	" 18	" 11	11 50

These Collets are provided with Threaded Holes for drawing in bolt.

TOOLS FOR USE ON AUTOMATIC GEAR CUTTING MACHINES.

The tools in the following lists we have found to be among those first needed in using these machines.

At the prices stated they can be sold only in full sets.

They are shipped with each machine and, if not wanted, are to be carefully re-packed and returned by express, at our expense.

FOR

Nos. 3 & 13 Automatic Gear Cutting Machines.

V Collet and No. 10 Key. One each I, J and K Arbors.
Eleven Bushings, as follows:
For I Arbor, 3-4" x 3", 7-8" x 3", 1" x 3", 1 1-8" x 3".
For J Arbor, 1 1-4" x 3 1-2", 1 3-8" x 3 1-2", 1 1-2" x 3 1-2", 1 5-8" x 3 1-2".
For K Arbor, 1 3-4" x 3 1-2", 2" x 3 1-2", 2 1-4" x 3 1-2".

Price, $40 00.

For No. 4 Automatic Gear Cutting Machines.

W Collet and No. 11 Key. One each M, N and O Arbors.
Eleven Bushings, as follows:
For M Arbor, 1" x 3 1-2", 1 1-8" x 3 1-2", 1 1-4" x 3 1-2", 1 3-8" x 3 1-2".
For N Arbor, 1 1-2" x 5", 1 5-8" x 5", 1 3-4" x 5", 2" x 5".
For O Arbor, 2 1-4" x 5", 2 3-4" x 5", 3" x 5".

Price, $48 00.

One Bushing,—2 1-2" x 5", furnished with machine.

For No. 5 Automatic Gear Cutting Machines.

X Collet and No. 12 Key. One each Q, R and S Arbors.
Nine Bushings, as follows:
For Q Arbor, 1 1-2" x 4 1-2", 1 5-8" x 4 1-2", 1 3-4" x 4 1-2", 2" x 4 1-2", 2 1-4" x 4 1-2".
For R Arbor, 2 1-2" x 6", 2 3-4" x 6".
For S Arbor, 3 1-4" x 6", 3 1-2" x 6".

Price, $58 00.

One Bushing,—3" x 6", furnished with machine.

For No. 6 Automatic Gear Cutting Machines.

Y Collet and No. 14 Key. One each U, V and W Arbors.
Nine Bushings, as follows:
For U Arbor, 2 1-4" x 6", 2 1-2" x 6", 2 3-4" x 6".
For V Arbor, 3" x 7 1-2", 3 1-4" x 7 1-2", 3 1-2" x 7 1-2", 3 3-4" x 7 1-2".
For W Arbor, 4 1-2" x 9", 5" x 9".

Price, $75 00.

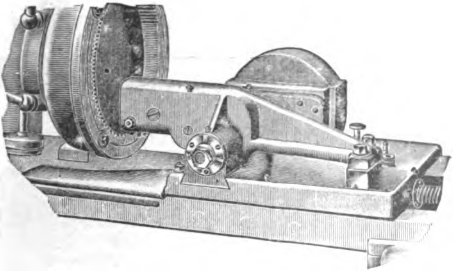
One Bushing,—4" x 7 1-2", furnished with machine.

For Arbors, Bushings and Collets, see pages 134, 135.

INTERNAL GEAR CUTTING ATTACHMENTS

FOR

Nos. 3, 4, 5 and 6 Automatic Gear Cutting Machines.



The Holder or Frame is secured to the cutter slide and the cutter spindle of the Attachment is driven by the main cutter spindle of the machine through a train of gears.

All cylindrical bearings are hardened and ground.

Diameter of Cutters for No. 3, 2 3-4″; No. 4, 3 1-4″; No. 5, 4 1-4″; No. 6, 4 3-4″.

Diameter of Arbors furnished: No. 3, 1″; No. 4, 1″ and 1 1-4″; No. 5, 1 1-4″ and 1 1-2″; No. 6, 1 1-2″ and 1 3-4″.

A convenient method of holding the work is shown in cut.

Weights for Shipment: No. 3, about 40 lbs.; No. 4, about 93 lbs.; No. 5, about 145 lbs.; No. 6, about 180 lbs.

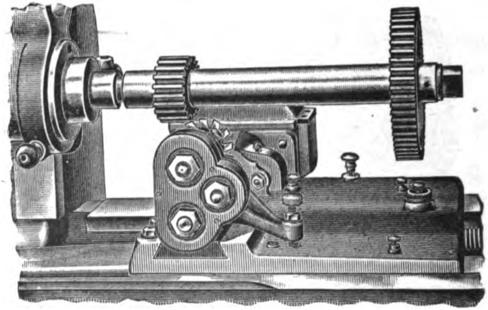
Dimensions of boxes in which Attachments are shipped: No. 3, 20″ x 9″ x 9″; No. 4, 22″ x 11″ x 10″; No. 5, 29″ x 13″ x 12″; No. 6, 30″ x 14″ x 12″.

No.	Machines where used.	Widest Face that can be cut.	Smallest Inside Diam. of Gear that can be cut.	Coarsest Pitch that can be cut.	Price.
3	No. 3	2 1-8″	3 1-4″	9	$
4	No. 4	3 1-2	4 1-4	6	$
5	No. 5	4 1-4	5 1-4	4	$
6	No. 6	3 3-4	6 1-2	3	$

QUILL GEAR CUTTING ATTACHMENTS

FOR

Nos. 3 and 4 Automatic Gear Cutting Machines.



These attachments are for cutting the small members of quill gears, as shown in cut, or other gears of similar construction.

They are easily and quickly placed in position or removed.

The cutter spindle is raised above the cutter spindle of the machine and driven by a train of gears.

Net Weights: No. 3, 25 lbs.; No. 4, 40 lbs.

No.	Machine where used.	Coarsest Pitch that can be cut.	Diameter of Cutter.	Greatest Difference in Diameter Large and Small Gear.	Price.
	3	6	3"	9"	$
4	4	4	3 3-4	13 1-2	$

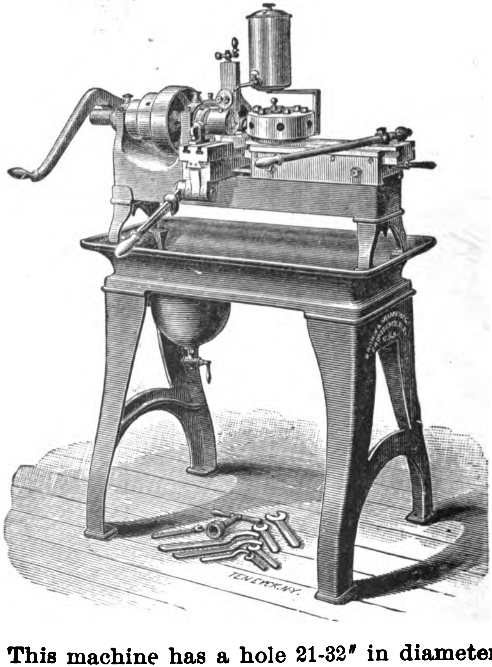
TABLE OF CUTTING SPEEDS.

FEET PER MINUTE	15′	20′	25′	30′	35′	40′	45′	50′	60′	70′	80′
DIAM.	REVOLUTIONS PER MINUTE.										
1/16	917.	1223.	1528.	1834.	2140.	2445.	2751.	3057.	3668.	4280.	4891.
1/8	459.	611.	764.	917.	1070.	1222.	1375.	1528.	1834.	2139.	2445.
3/16	306.	408.	509.	611.	713.	815.	917.	1019.	1222.	1426.	1630.
1/4	229.	306.	382.	458.	535.	611.	688.	764.	917.	1070.	1222.
5/16	183.	245.	306.	367.	428.	489.	550.	611.	733.	856.	978.
3/8	153.	204.	255.	306.	357.	408.	458.	509.	611.	713.	815.
7/16	131.	175.	218.	262.	306.	349.	393.	437.	524.	611.	699.
1/2	115.	153.	191.	229.	268.	306.	344.	382.	459.	535.	611.
5/8	91.8	123.	153.	184.	214.	245.	276.	306.	367.	428.	489.
3/4	76.3	102.	127.	153.	178.	203.	229.	254.	306.	357.	408.
7/8	65.5	87.3	109.	131.	153.	175.	196.	219.	262.	306.	349.
1	57.3	76.4	95.5	115.	134.	153.	172.	191.	229.	267.	306.
1 1/8	51.0	68.0	85.0	102.	119.	136.	153.	170.	204.	238.	272.
1 1/4	45.8	61.2	76.3	91.8	107.	123.	137.	153.	183.	214.	245.
1 3/8	41.7	55.6	69.5	83.3	97.2	111.	125.	139.	167.	195.	222.
1 1/2	38.2	50.8	63.7	76.3	89.2	102.	115.	127.	153.	178.	204.
1 5/8	35.0	47.0	58.8	70.5	82.2	93.9	106.	117.	141.	165.	188.
1 3/4	32.7	43.6	54.5	65.5	76.4	87.3	98.2	109.	131.	153.	175.
1 7/8	30.6	40.7	50.9	61.1	71.3	81.5	91.9	102.	122.	143.	163.
2	28.7	38.2	47.8	57.3	66.9	76.4	86.0	95.5	115.	134.	153.
2 1/4	25.4	34.0	42.4	51.0	59.4	68.0	76.2	85.0	102.	119.	136.
2 1/2	22.9	30.6	38.2	45.8	53.5	61.2	68.8	76.3	91.7	107.	122.
2 3/4	20.8	27.8	34.7	41.7	48.6	55.6	62.5	69.5	83.4	97.2	111.
3	19.1	25.5	31.8	38.2	44.6	51.0	57.3	63.7	76.4	89.1	102.
3 1/2	16.4	21.8	27.3	32.7	38.2	43.6	49.1	54.5	65.5	76.4	87.4
4	14.3	19.1	23.9	28.7	33.4	38.2	43.0	47.8	57.3	66.9	76.4
4 1/2	12.7	16.9	21.2	25.4	29.6	34.0	38.2	42.4	51.0	59.4	67.9
5	11.5	15.3	19.1	22.9	26.7	30.6	34.4	38.2	45.9	53.5	61.1
5 1/2	10.4	13.9	17.4	20.8	24.3	27.8	31.3	34.7	41.7	48.6	55.6
6	9.6	12.7	15.9	19.1	22.3	25.5	28.7	31.8	38.2	44.6	51.0
7	8.1	10.9	13.6	16.4	19.1	21.8	24.6	27.3	32.7	38.2	43.7
8	7.2	9.6	11.9	14.3	16.7	19.1	21.1	23.9	28.7	33.4	38.2
9	6.4	8.5	10.6	12.7	14.9	17.0	19.1	21.2	25.5	29.7	34.0
10	5.7	7.6	9.6	11.5	13.4	15.3	17.2	19.1	22.9	26.7	30.6
11	5.2	6.9	8.7	10.4	12.2	13.9	15.6	17.4	20.8	24.3	27.8
12	4.8	6.4	8.0	9.6	11.1	12.7	14.3	15.9	19.1	22.3	25.5
13	4.4	5.9	7.3	8.8	10.3	11.8	13.2	14.7	17.6	20.6	23.5
14	4.1	5.5	6.8	8.[illegible]	9.6	10.9	12.3	13.6	16.4	19.1	21.8
15	3.8	5.1	6.4	7.6	8.9	10.2	11.5	12.7	15.3	[illegible]	20.4
16	3.6	4.8	6.0	7.2	8.4	9.6	10.7	11.9	14.3	16.7	19.1

[illegible] No. 3

21-32 in. x 3 1-2 in.

PLAIN SCREW MACHINE.



This machine has a hole 21-32″ in diameter through spindle and turns any length to 3 1-2″.

Greatest distance between turret and front of chuck, 8″.

No. 3

21-32 in. x 3 1-2 in.

PLAIN SCREW MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of steel and phosphor bronze.

The Hole through spindle is 21-32" in diameter.

A Chasing Bar, provided with a 16 pitch leader and nut, is furnished with this machine.

The Cone has 3 steps for 2" belt.

The Turret has 6 holes 13-16" in diameter; distance from centre of holes to top of slide, 1 19-32"; greatest distance attainable between turret and front of chuck, 8".

Swing over bed, 9 3-8"; over cross slide, 3 1-2"; with chasing bar in position, 3"; length that can be turned, 3 1-2".

The Tank Table has a reservoir cast in the bottom, providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys, 10" in diameter for 3" belts, and should run about 270 revolutions per minute.

Weight of machine ready for domestic shipment, about 710 lbs.

Weight of machine ready for foreign shipment, about 930 lbs.

Net Weight, about 650 lbs.

Floor Space, 30"x 50".

Dimensions of boxes in which machine is shipped, 45"x 16"x 23", and 55"x 26"x 19".

Price includes oil can, chuck, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, Pipes, etc., are furnished when desired.

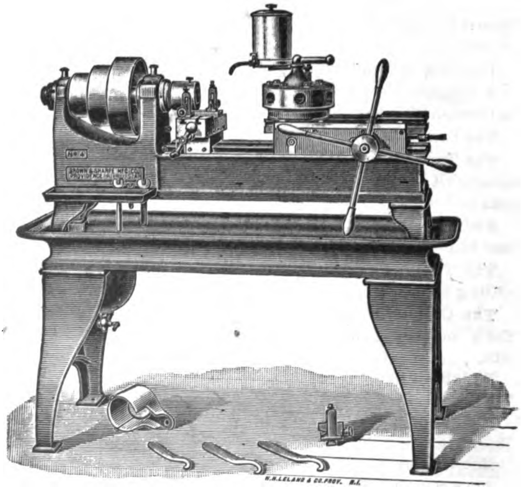
Price, $

For Tools and Attachments, see pages 172 to 183.

No. 4

1 9-32 in. x 6 in.

PLAIN SCREW MACHINE.



This machine has a hole 1 9-32″ in diameter through spindle and turns any length to 6″.

Greatest distance between turret and front of chuck, 18″.

No. 4 1 9-32 in. x 6 in.
PLAIN SCREW MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through spindle is 1 9-32" in diameter.

The Cone has 3 steps for 3" belt.

The Turret has 7 holes 1 1-2" in diameter; distance from centre of holes to top of slide, 2 3-4"; greatest distance between turret and front of chuck, 18".

Swing over bed, 13 3-8"; over cross slide, 5"; length that can be turned, 6".

The Tank Table has a reservoir cast in the bottom, providing for the collection of strained oil.

The Counter-shaft has 2 friction pulleys 14" in diameter for 3 1-2" belts, and should run about 190 revolutions per minute

Weight of machine ready for domestic shipment, about 1490 lbs.

Weight of machine ready for foreign shipment, about 1650 lbs.

Net Weight, about 1275 lbs. **Floor Space**, 27"x 62".

Dimensions of boxes in which machine is shipped, 62"x 20"x 28", and 65"x 25"x 23".

Price includes oil can, chuck, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, Pipes, etc., are furnished when desired.

Price, $

For Tools and Attachments, see pages 172 to 183.

No. 5 1 9-32 in. x 6 in.
PLAIN SCREW MACHINE.

This machine is the same as the No. 4 Screw Machine, except that a chasing bar with a 12-pitch leader and nut is added.

Swing over cross slide with chasing bar in position, 3 3-4".

Weight of machine ready for domestic shipment, about 1525 lbs.

Weight of machine ready for foreign shipment, about 1820 lbs.

Net Weight, about 1400 lbs. **Floor Space**, 27"x 68".

Dimensions of boxes in which machine is shipped, 67"x 23"x 32", and 65"x 25"x 23".

Price, $

An Oil Pump, Pipes, etc., are furnished when desired.

Price, $

For Tools and Attachments, see pages 172 to 183.

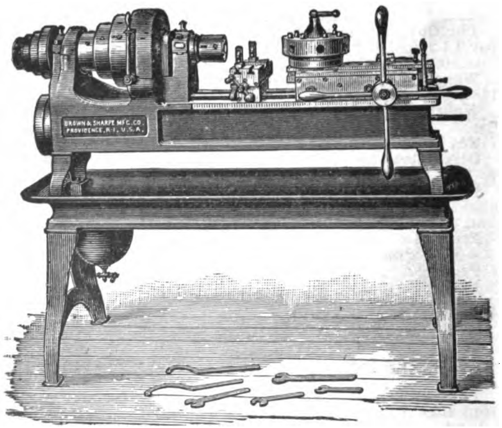
No. 6

1 9-16 in. x 8 in.

PLAIN SCREW MACHINE.

Back Geared.

Patented Oct. 15, 18 9; May 23, 1893; July 24, 1894; Jan. 6, 1903.



This machine has a hole 1 9-16″ in diameter through spindle and turns any length to 8″.

Greatest distance between turret and front of chuck, 19″.

No. 6

1 9-16 in. x 8 in.

PLAIN SCREW MACHINE.

Back Geared.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through spindle is 1 9-16" in diameter.

The Cone has 3 steps for 3" belt and is back geared. The back gears are under spindle, and, together with the gears on cone, are enclosed. These gears run continuously and are engaged or disengaged by a clutch, operated by a lever on the front of the machine.

The Turret has 7 holes 1 1-2" in diameter and can be clamped in position. Distance from centre of holes to top of slide, 2 3-4"; to top of feed case, 2 1-2"; greatest distance between turret and face of chuck, 19".

The Feed of turret slide is automatic and has 8 changes, varying from .005" to .030" to one revolution of spindle. The feed cones have 4 steps and, by the movement of a lever, each of the four speeds of cones can be made fast or slow without changing the belt.

Independent Stops, which are easy of access and automatic with the turret, are provided for each hole in the turret.

Swing over bed, 13 3-8"; over cross slide, 5 7-8". **Length** that can be turned, 8".

The Tank Table has a reservoir cast in the bottom, providing for the collection of strained oil.

The Counter-shaft has 2 friction pulleys 14" in diameter for 3 1-2" belts and should run about 175 revolutions per minute.

Weight of machine ready for domestic shipment, about 2200 lbs.

Weight of machine ready for foreign shipment, about 2325 lbs.

Net Weight, about 1800 lbs.

Floor Space, 30"x 86".

Dimensions of boxes in which machine is shipped, 74"x 28" x 32", and 75"x 26"x 20".

Price includes chuck, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, Pipes, etc., are furnished when desired.

Price, $

For Tools and Attachments, see pages 172 to 184.

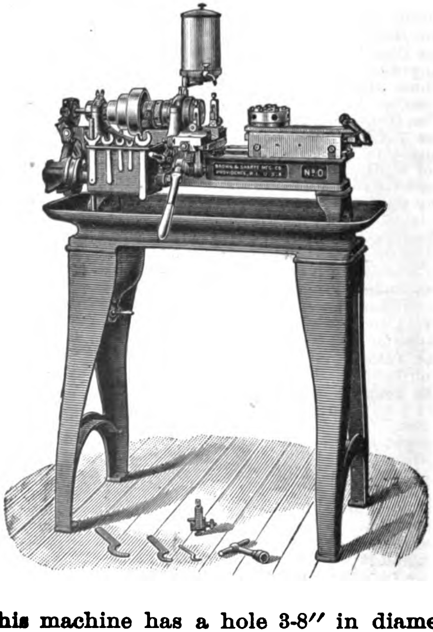
No. 0

3-8 in. x 2 1-4 in.

WIRE FEED SCREW MACHINE.

Automatic Feed.

Patented April 1, 1890; July 30, 1895; Sept. 29, 1896.



This machine has a hole 3-8″ in diameter through largest feeding finger and turns any length to 2 1-4″

No. 0

3-8 in. x 2 1-4 in.

WIRE FEED SCREW MACHINE.

Automatic Feed.

The Spindle is of steel; the bearings are hardened, ground and lapped, and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through largest feeding finger is 3-8" in diameter, through feed tube 13-32", through spindle without feed tube 11-16".

The Chuck and Wire Feed are automatic. By pressing the small lever on the front of the head-stock the chuck is opened, stock fed forward and chuck closed. This operation may be repeated several times if it should be desired to feed a greater length than that for which the mechanism is adjusted. The feeding mechanism can also be operated by the movement of the cross slide lever, thus avoiding the necessity of removing the hand from the lever. Ordinary variations in size of stock make no difference in the accurate feeding of the machine. The feed is uniform and the holding capacity of the chuck may be made as strong as desired without extra labor for the operation.

With one movement of either of the levers the machine feeds any length to 3". By pressing the lever several times, the stock is fed forward a length equal to the corresponding multiples of the distance for which the machine is adjusted. The adjustment is fine and readily made.

The Cone has 3 steps for 1 1-4" belt.

The Turret has 6 holes 5-8" in diameter; distance from centre of holes to top of slide, 1 1-16"; greatest distance attainable between turret and front of chuck, 7".

Swing over cross slide, 3 1-8"; length that can be turned, 2 1-4".

The Tank Table has a reservoir cast in the bottom providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys 8" in diameter for 2 1-2" belts, and should run about 430 revolutions per minute for iron or steel, and 750 for brass.

Weight of machine ready for domestic shipment, about 685 lbs.; for foreign shipment, about 780 lbs.

Net Weight about 530 lbs. **Floor Space**, 26" x 47".

Dimensions of boxes in which machine is shipped, 41" x 19" x 19", and 53" x 23" x 18".

Price includes oil can, 3-8" spring collet and feeding finger, 2 wire stands, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. **Price, $**

Oil Pump, Pipes, etc., furnished when desired. Price, $

Counter-shaft with 3 pulleys. **Price, $**

For Tools and Sets of Tools, see pages 172 to 184.

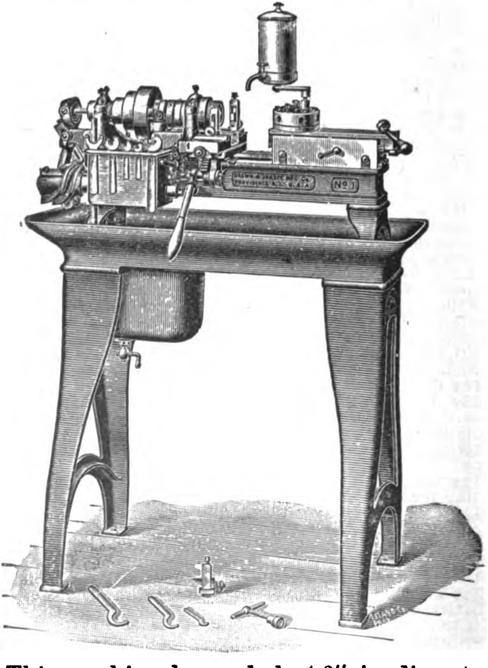
No. 1

1-2 in. x 3 in.

WIRE FEED SCREW MACHINE.

Automatic Feed.

Patented April 1, 1890; July 30, 1895; Sept. 29, 1896.



This machine has a hole 1-2″ in diameter through largest feeding finger and turns any length to 3″.

No. 1
1-2 in. x 3 in.
WIRE FEED SCREW MACHINE.
Automatic Feed.

The Spindle is of steel, the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at the rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through largest feeding finger is 1-2" in diameter, through feed tube 17-32", through spindle without feed tube 13-16". Feeding fingers for 5-8" brass or other light work furnished when desired.

The Chuck and Wire Feed are automatic. By pressing the small lever on the front of the head-stock of the machine, the chuck is opened, stock fed forward and chuck closed. This operation may be repeated several times if it should be desired to feed a greater length than that for which the mechanism is adjusted. The chuck is so constructed that ordinary variations in size of the stock make no difference in accurate feeding, and no stop is usually required. The feed is uniform and the holding capacity of the chuck may be made as strong as desired without extra labor for the operation.

With one movement of the lever the machine feeds any length to 4". By pressing the lever several times, the stock is fed forward a length equal to the corresponding multiples of the distance for which the machine is adjusted. The adjustment is fine and readily made.

The Cone has 3 steps for 1 3-4" belt.

The Turret has 6 holes 3-4" in diameter; distance from centre of holes to top of slide, 1 1-2"; greatest distance attainable between turret and front of chuck, 9 3-4".

Swing over bed, 9 1-4"; over cross slide, 4 1-8"; length that can be turned, 3".

The Tank Table has a reservoir cast in the bottom providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys 10" in diameter for 3" belts and should run about 305 revolutions per minute for iron or steel, and 550 for brass.

Weight of machine ready for domestic shipment, about 1000 lbs; for foreign shipment, about 1220 lbs.

Net Weight, about 900 lbs. **Floor Space**, 29" x 59".

Dimensions of boxes in which machine is shipped, 50" x 22" x 22", and 65" x 25" x 18".

Price includes oil can, 1-2" spring collet and feeding finger, wrenches, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. Price, $

Oil Pump, Pipes, etc., furnished when desired. Price, $

Counter-shaft furnished with 3 pulleys.

Price, $

For Tools and Attachments, see pages 172 to 184.

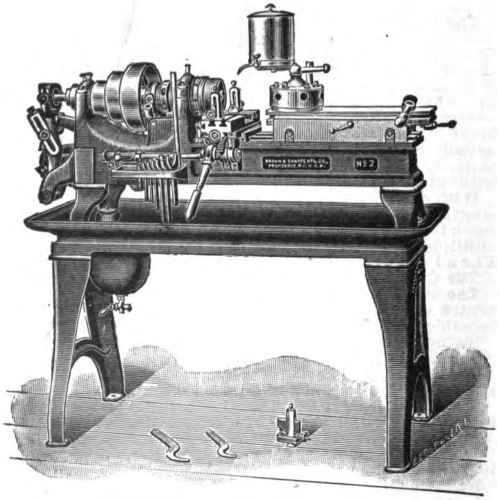
No. 2

7-8 in. x 4 in.

WIRE FEED SCREW MACHINE.

Automatic Feed.

Patented April 1, 1890; July 30, 1895; Sept. 29, 1896.



This machine has a hole 7-8″ in diameter through largest feeding finger and turns any length to 4″.

No. 2
7-8 in. x 4 in.
WIRE FEED SCREW MACHINE.
Automatic Feed.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through largest feeding finger is 7-8" in diameter, through feed tube 15-16", through spindle without feed tube, 1 3-16".

The Chuck and Wire Feed are automatic. By pressing the small lever on the front of the head-stock the chuck is opened, stock fed forward and chuck closed. This operation may be repeated several times if it should be desired to feed a greater length than that for which the mechanism is adjusted. The feeding mechanism can also be operated by the movement of the cross slide lever, thus avoiding the necessity of removing the hand from the lever.

Ordinary variations in size of stock make no difference in the accurate feeding of the machine. The feed is uniform and the holding capacity of the chuck may be made as strong as desired without extra labor for the operation.

With one movement of either of the levers, the machine feeds any length to 5". By pressing the lever several times, the stock is fed forward a length equal to the corresponding multiples of the distance for which the machine is adjusted. The adjustment is fine and readily made.

The Cone has 3 steps for 2 1-2" belt.

The Turret has 6 holes 1" in diameter; distance from centre of holes to top of slide, 2"; greatest distance attainable between turret and front of chuck, 11".

Swing over bed, 10 1-2"; over cross slide, 5"; length that can be turned, 4".

The Tank Table has a reservoir cast in the bottom providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys 12" in diameter for 3 1-2" belts, and should run about 220 revolutions per minute for iron or steel, and 380 for brass.

Weight of Machine ready for domestic shipment, about 1725 lbs.; for foreign shipment, about 1800 lbs.

Net Weight, about 1375 lbs. **Floor Space**, 33" x 72".

Dimensions of boxes in which machine is shipped, 64"x 25" x 26", and 66"x 28"x 21".

Price includes oil can, 7-8" spring collet and feeding finger, wrenches, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I. **Price, $**

Oil Pump, Pipes, etc., furnished when desired. **Price, $**

Counter-shaft with 3 pulleys. **Price, $**

Power feed for turret slide, see page 177.

For Tools and Sets of Tools, see pages 172 to 184.

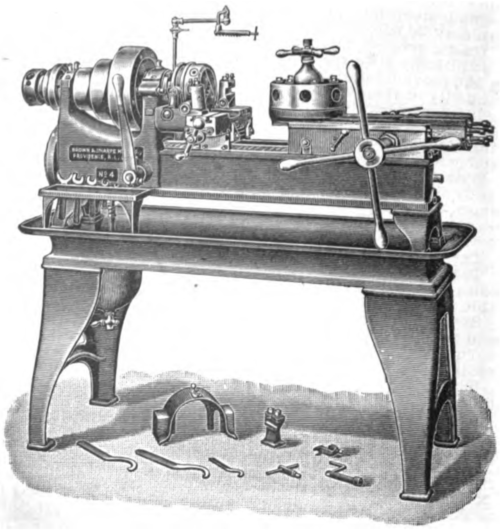
No. 4

1 1-4 in. x 6 in.

WIRE FEED SCREW MACHINE.

Roller Feed.

Patented July 24, 1894; Other Patents Pending.



This machine has a hole 1 9-32″ in diameter through spindle and turns any length to 6″.

No. 4 1 1-4 in. x 6 in.
WIRE FEED SCREW MACHINE.
Roller Feed.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through spindle is 1 9-32".

The Chuck and Roller Feed are automatic. By swinging the lever on the front of the head-stock toward the rear of the machine, the chuck is opened and the stock fed forward against the stock stop; and by returning the lever to a vertical position, the chuck is closed. The mechanism is so arranged as to prevent any possibility of the lever becoming loosened and causing the chuck to open.

The Chuck is adjustable and takes all sizes of stock from 3-8" to 1 1-4" in diameter. It is exceptionally strong and compensates automatically for variations as great as 1-32" in the size of stock. There are two hardened jaws that interlock and will take round, square or hexagonal stock. Means are provided for attaching special jaws for irregular or odd-shaped pieces.

The Roller Feed is self-contained and located in the cone at the front end. Graduations on the disk at the front of the cone facilitate setting the feed to the required size of stock. It feeds any length within the capacity of the machine without the necessity of manipulating cams or similar devices. All parts most subject to wear are carefully hardened and protected from dirt and injury.

The Feed of Turret Slide is automatic and has 3 changes evenly graded from .005" to .015" to one revolution of spindle.

The Cone has 3 steps for 3" belt.

The Turret has 7 holes 1 1-2" in diameter; distance from centre of holes to top of slide, 2"; greatest distance attainable between turret and front of chuck, 11".

Swing over bed, 13 3-8"; over cross slide, 5"; length that can be turned, 6".

The Tank Table has a reservoir cast in the bottom providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys 14" in diameter for 3 1-2" belts and should run about 190 revolutions per minute.

Weight of Machine ready for domestic shipment, about 1500 lbs.; for foreign shipment, about 1700 lbs.

Net Weight, about 1300 lbs. **Floor Space**, 27"x 62".

Dimensions of box in which machine is shipped, 62"x 20" x 28".

Price includes pump and piping, chuck, wrenches and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

Counter-shaft with 3 pulleys. **Price, $**

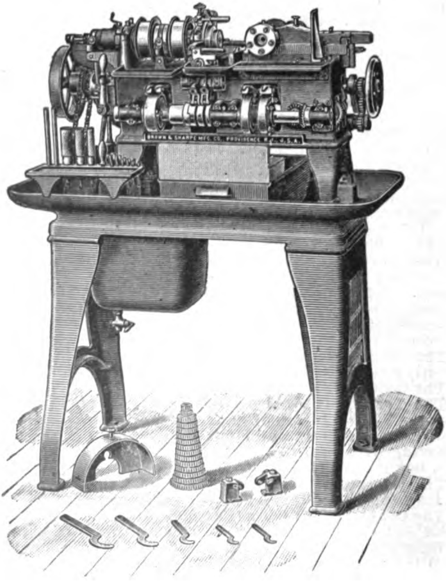
For Tools and Sets of Tools, see pages 172 to 184.

No. 00

5-16 in. x 1 in.

AUTOMATIC SCREW MACHINE.

Patented April 1, 1890; May 16, 1893; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 5-16″ in diameter through largest feeding finger and turns any length to 1″.

No. 00

5-16 in. x 1 in.

AUTOMATIC SCREW MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze. The spindle has 2 friction clutch pulleys, 4" in diameter for 1 1-4" belts. These pulleys are bushed with steel and run on roller bearings. There are 12 changes of speed, varying from 420 to 2400 revolutions per minute.

The Hole through largest feeding finger is 5-16" in diameter, through feed tube, 21-64".

The Collets are easily changed and adjusted by nuts at the rear end of spindle.

The Turret has 5 holes, 5-8" in diameter, and revolves vertically on the side of the turret slide. Greatest distance attainable between front of spindle and turret, 2 3-4".

The Movements of the turret slide, the changing of tools, the operation of chuck, the feeding of stock and the reversing of spindle are controlled by quick running cams driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs which are easy of access and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine. The return and change movements are extremely rapid and, by the accurate timing that the machine admits of, work can be rapidly done.

The Feeding Mechanism is accurate, feeds any length to 2" and any length to 1" can be turned. By operating the mechanism several times the stock is fed forward a length equal to the corresponding multiples for which the machine is adjusted. The adjustment is fine and readily made.

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

The Counter-shaft has tight and loose pulleys 8" in diameter for 3" belt, and should run about 450 revolutions per minute.

Weight of machine ready for domestic shipment, about 1265 lbs.; for foreign shipment, about 1400 lbs.

Net Weight, about 1000 lbs. **Floor Space**, 22"x 40".

Dimensions of boxes in which machine is shipped, 44"x 20" x 24", and 74"x 26"x 20".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 2 to 20 pieces per minute, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

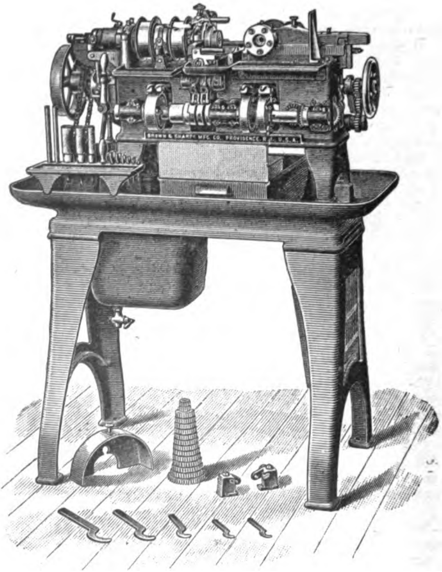
For Tools and Attachments, see pages 172 to 185.

No. 0

1-2 in. x 1 3-4 in.

AUTOMATIC SCREW MACHINE.

Patented April 1, 1890, May 16, 1893; July 30, 1895;
May 17, 1898; April 11, 1899.



This machine has a hole 1-2″ in diameter through largest feeding finger and turns any length to 1 3-4″.

No. 0

1-2 in. x 1 3-4 in.

AUTOMATIC SCREW MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze. The spindle has 2 friction clutch pulleys, 6″ in diameter for 2″ belts. These pulleys are bushed with steel and run on roller bearings. There are 10 changes of speed, varying from 150 to 1800 revolutions per minute.

The Hole through largest feeding finger is 1-2″ in diameter, through feed tube 17-32″.

The Collets are easily changed and adjusted by nuts at the rear end of spindle.

The Turret has 6 holes, 3-4″ in diameter, and revolves vertically on the side of the turret slide. Greatest distance attainable between front of spindle and turret, 4 1-2″.

The Movements of the turret slide, the changing of tools, the operation of chuck, the feeding of stock and the reversing of spindle are controlled by quick running cams driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs which are easy of access and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine. The return and change movements are extremely rapid, and, by the accurate timing that the machine admits of, work can be rapidly done.

The Feeding Mechanism is accurate, feeds any length to 3″ and any length to 1 3-4″ can be turned. By operating the mechanism several times the stock is fed forward a length equal to the corresponding multiples for which the machine is adjusted. The adjustment is fine and readily made.

The Cross Slide Tools are on separate slides, so that one or both can be used as desired.

The Counter-shaft has 2 tight and loose pulleys 10″ in diameter, for 3 1-4″ belts, and should run about 140 and 420 revolutions per minute.

Weight of machine ready for domestic shipment, about 1735 lbs; for foreign shipment, about 1925 lbs.

Net Weight, about 1400 lbs. **Floor Space**, 23″ x 51″.

Dimensions of boxes in which machine is shipped, 53″ x 25″ x 27″, and 80″ x 27″ x 22″.

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 1 piece in 2 minutes to 12 pieces in 1 minute, 2 wire stands, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

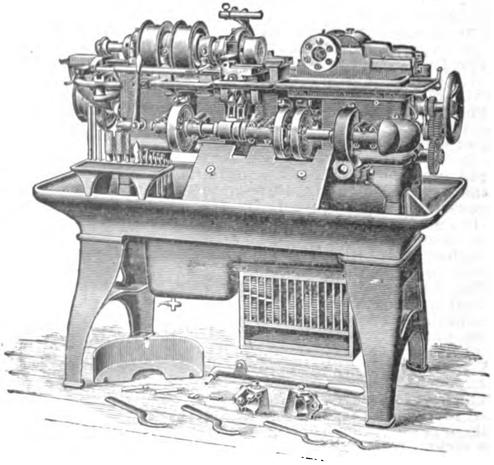
For Tools and Attachments, see pages 172 to 186.

No. 2

7-8 in. x 2 1-2 in.

AUTOMATIC SCREW MACHINE.

Patented April 1, 1890; May 16, 1893; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 7-8″ in diameter through largest feeding finger and turns any length to 2 1-2″.

No. 2

7-8 in. x 2 1-2 in.

AUTOMATIC SCREW MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze. The spindle has 2 friction clutch pulleys, 7" in diameter for 2 1-2" belts. These pulleys are bushed with steel and run on roller bearings. There are 12 changes of speed, varying from 120 to 1200 revolutions per minute. Spindle speeds changed automatically.

The Hole through largest feeding finger is 7-8" in diameter, through feed tube, 1 1-32". Feeding fingers for Brass or other light work to take stock 1" in diameter, furnished when desired.

The Collets are easily changed and adjusted by a nut between front bearing and first pulley on spindle.

The Turret has 6 holes, 1" in diameter, and revolves vertically on the side of the turret slide. Greatest distance attainable between front of spindle and turret, 6 1-4"; least 2 1-2".

The Movements of the turret slide, the changing of tools, the operation of chuck, the feeding of stock and the reversing of spindle are controlled by quick running cams driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs which are easy of access and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine. The return and change movements are extremely rapid.

The Feeding Mechanism is accurate, feeds any length to 4" and any length to 2 1-2" can be turned. By operating the mechanism several times the stock is fed forward a length equal to the corresponding multiples for which the machine is adjusted. The adjustment is fine and readily made.

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

The Counter-shaft has two tight and loose pulleys 12" in diameter for 3 1-2" belts, and should run about 170 and 340 revolutions per minute.

Weight of machine ready for domestic shipment, about 2650 lbs.; for foreign shipment, about 2900 lbs.

Net Weight, about 2125 lbs. **Floor Space,** 26"x 60".

Dimensions of boxes in which machine is shipped, 63"x 28" x 29", and 96"x 33"x 26".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 20 to 600 pieces per hour, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Tools and Attachments, see pages 172 to 189.

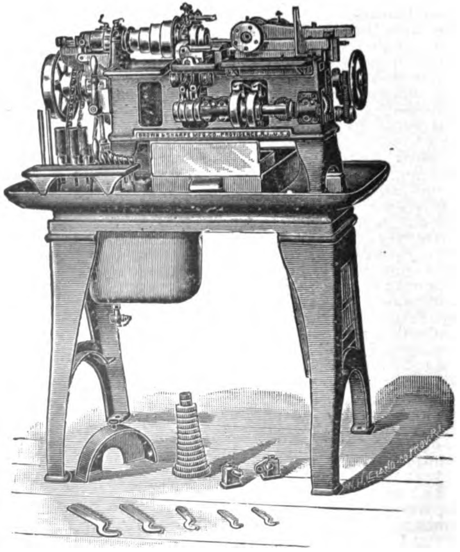
No. 00

5-16 in. x 1 in.

AUTOMATIC TURRET FORMING MACHINE.

For Work Not Tapped.

Patented April 1, 1890; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 5-16″ in diameter through largest feeding finger and turns any length to 1″.

No. 00

5-16 in. x 1 in.

AUTOMATIC TURRET FORMING MACHINE.

For Work Not Tapped.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Cone has 4 steps, the largest 4 1-2" in diameter for 1 1-4" belt, and gives 4 changes of spindle speed, from 540 to 2400 revolutions per minute.

The Hole through largest feeding finger is 5-16" in diameter, through feed tube, 21-64".

The Collets are easily changed and adjusted by nuts at rear end of spindle.

The Turret has 5 holes, 5-8" in diameter, and revolves vertically on the side of the turret slide. The turret tools turn any length to 1". Greatest distance attainable between front of spindle and turret, 2 3-4".

The Movements of the turret slide, the changing of the tools, the operation of the chuck and the feeding of stock are controlled by quick running cams, driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs, which are easy of access and quickly adjusted. The lead and cross slide cams are steel disks, which can be cheaply formed and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine.

The Feeding Mechanism is accurate and feeds any length to 2", and, by adjusting the extra dogs furnished with the machine, the stock can be fed forward a length greater than 2".

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

Tables giving the proper speed for different sizes and kinds of stock are sent with each machine.

The Counter-shaft has tight and loose pulleys 8" in diameter for 3" belt, and should run about 400 revolutions per minute.

Weight of machine ready for domestic shipment, about 930 lbs.; for foreign shipment, about [illegible] lbs.

Net Weight, about 740 lbs. Floor Space, 22" x 40".

Dimensions of boxes in which machine is shipped, 44" x 20" x 24", and 58" x 26" x [illegible]".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 2 to 20 pieces per minute, 2 wire stands, and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Tools and Attachments see pages 172 to 185.

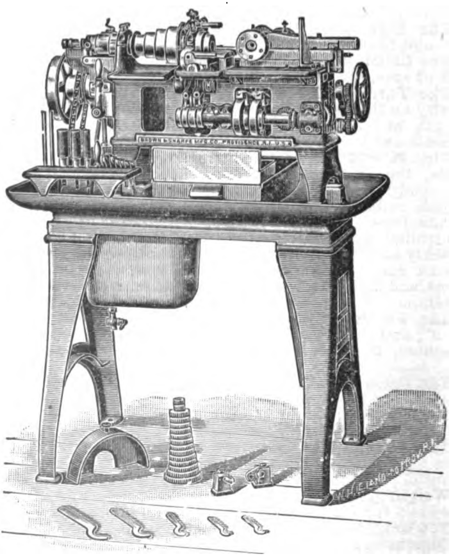
No. 0

1-2 in. x 1 3-4 in.

AUTOMATIC TURRET FORMING MACHINE.

For Work Not Tapped.

Patented April 1, 1890; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 1-2″ in diameter through largest feeding finger, and turns any length to 1 3-4″.

No. 0
1-2 in. x 1 3-4 in.
AUTOMATIC TURRET FORMING MACHINE.
For Work Not Tapped.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Cone has 3 steps, the largest 6 1-4" in diameter for 2 1-4" belt, and gives 6 changes of spindle speed, from 350 to 1800 revolutions per minute.

The Hole through largest feeding finger is 1-2" in diameter, through feed tube, 17-32".

The Collets are easily changed and adjusted by nuts at rear end of spindle.

The Turret has 6 holes, 3-4" in diameter and revolves vertically on the side of the turret slide. The turret tools turn any length to 1 3-4". Greatest distance attainable between front of spindle and turret, 4 1-2".

The Movements of the turret slide, the changing of the tools, the operation of the chuck and the feeding of stock are controlled by quick running cams, driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs, which are easy of access and quickly adjusted. The lead and cross slide cams are steel disks, which can be cheaply formed and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine.

The Feeding Mechanism is accurate and feeds any length to 3", and, by adjusting the extra dogs furnished with the machine, the stock can be fed forward a length greater than 3".

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

Tables giving the proper speed for different sizes and kinds of stock are sent with each machine.

The Counter-shaft has 2 tight and 2 loose pulleys 8" in diameter, for 3" belt and should run about 200 and 400 revolutions per minute.

Weight of machine ready for domestic shipment, about 1350 lbs.; for foreign shipment, about 1550 lbs.

Net Weight, about 1160 lbs. **Floor Space**, 23" x 51".

Dimensions of boxes in which machine is shipped, 57" x 25" x 27", and 65" x 28" x 20".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 1 piece in 2 minutes to 12 in 1 minute, 2 wire stands, and everything else shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I. Price, $

For Tools and Attachments, see pages 172 to 186.

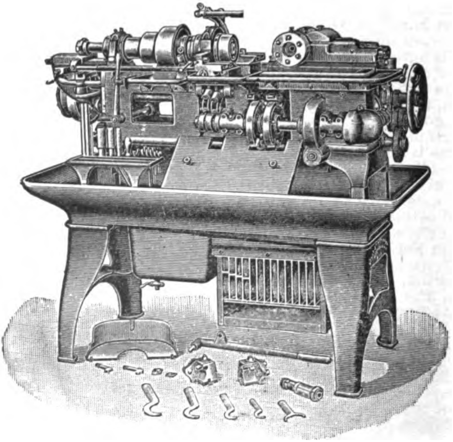
No. 2

7-8 in. x 2 1-2 in.

AUTOMATIC TURRET FORMING MACHINE.

For Work Not Tapped.

Patented April 1, 1890; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 7-8″ in diameter through largest feeding finger, and turns any length to 2 1-2″.

No. 2
7-8 in. x 2 1-2 in.
AUTOMATIC TURRET FORMING MACHINE.
For Work Not Tapped.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Cone has 3 steps, the largest 6 1-2" in diameter for 2 3-4" belt, and gives 8 changes of spindle speed, from 180 to 1440 revolutions per minute.

The Hole through largest feeding finger is 7-8" in diameter, through feed tube 1 1-32".

The Collets are easily changed and adjusted by a nut between first bearing and cone pulley on spindle.

The Turret has 6 holes, 1" in diameter, and revolves vertically on the side of the turret slide. The turret tools turn any length to 2 1-2". Greatest distance attainable between front of spindle and turret, 6 1-4"; least, 2 1-2".

The Movements of the turret slide, the changing of the tools, the operation of the chuck and the feeding of stock are controlled by quick running cams, driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs, which are easy of access and quickly adjusted. The lead and cross slide cams are steel or cast iron disks, which can be cheaply formed and easily adjusted. Instructions and diagrams for laying out the cams are sent with each machine.

The Feeding Mechanism is accurate and feeds any length to 4", and, by adjusting the extra dogs furnished with the machine, the stock can be fed forward a length greater than 4".

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

Tables giving the proper speed for different sizes and kinds of stock are sent with each machine.

The Counter-shaft has two friction pulleys 12" in diameter for 3 1-2" belts and should run about 170 and 340 revolutions per minute.

Weight of machine ready for domestic shipment, about 2180 lbs.; for foreign shipment, about 2475 lbs.

Net Weight, about 1900 lbs. **Floor Space**, 26"x 60".

Dimensions of boxes in which machine is shipped, 63"x 28" x 29", and 78"x 29"x 26".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 20 to 600 pieces per hour, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b at Providence, R. I. Price, $

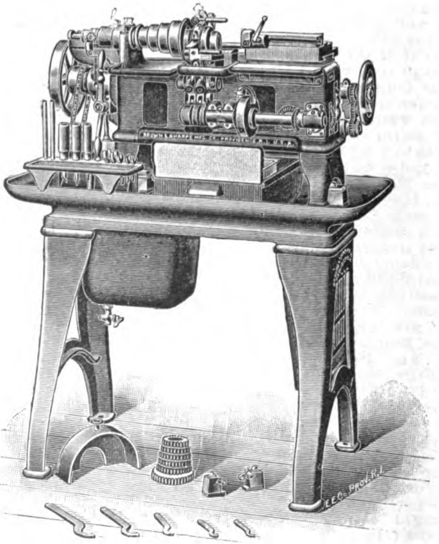
For Tools and Attachments, see pages 172 to 188.

No. 00

5-16 in. x 10 in.

AUTOMATIC CUTTING-OFF MACHINE.

Patented April 1, 1890; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 5-16″ in diameter through largest feeding finger and feeds any length to 2″ at a single movement of feeding mechanism, or to 10″ by successive movements.

No. 0

1-2 in. x 12 in.

AUTOMATIC CUTTING-OFF MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Cone has four steps, the largest 6 1-4" in diameter, for 1 3-4" belt, and gives 4 changes of spindle speed, from 420 to 1800 revolutions per minute.

The Hole through largest feeding finger is 1-2" in diameter, through feed tube 17-32".

The Collets are easily changed and adjusted by nuts at rear end of spindle.

The Tool Slide has a movement of 1 3-4", and a tool holder with hole 3-4" in diameter. The tool holder can be adjusted to any length between 2" and 12" from end of spindle.

The Operation of the chuck and the feeding of stock are controlled by quick running cams driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs which are easy of access and easily adjusted. The lead and cross slide cams are steel disks, which can be cheaply formed and quickly placed in position. Instructions and diagrams for laying out cams are sent with each machine.

The Feeding Mechanism feeds any length to 3", and, by adjusting the extra dogs furnished with the machine, the stock can be fed forward any length to 12".

The Cross Slide Tools are on separate slides so that one or both can be used as desired.

Tables, giving the proper speed for different sizes and kinds of stock, are sent with each machine.

The Counter-shaft has tight and loose pulleys 8" in diameter for 3" belt, and should run about 400 revolutions per minute.

Weight of machine ready for domestic shipment, about 1290 lbs.; for foreign shipment, about 1400 lbs.

Net Weight, about 1025 lbs. **Floor Space**, 23" x 51".

Dimensions of boxes in which machine is shipped, 54" x 27" x 25" and 65" x 28" x 21".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 1 piece in 1 1-2 minutes to 12 pieces in 1 minute, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

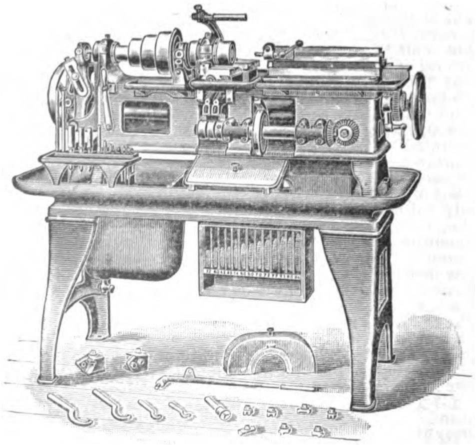
For Tools and Attachments, see pages 172 to 186.

No. 1

5-8 in. x 15 in.

AUTOMATIC CUTTING-OFF MACHINE.

Patented April 1, 1890; July 30, 1895; May 17, 1898; April 11, 1899.



This machine has a hole 5-8″ in diameter through largest feeding finger and feeds any length to 4″ at a single movement of feeding mechanism, or to 15″ by successive movements

No. 1

5-8 in. x 15 in.

AUTOMATIC CUTTING-OFF MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Cone has four steps, the largest 6 1-2" in diameter, for 2" belt, and gives 4 changes of spindle speed, from 360 to 1440 revolutions per minute.

The Hole through largest feeding finger is 5-8" in diameter, through feed tube, 21-32".

The Collets are easily changed and adjusted by a nut between front bearing and cone pulley on spindle.

The Tool Slide has a movement of 2", and a tool holder with hole 1" in diameter. The tool holder can be adjusted to any length between 2 1-2" and 15" from end of spindle.

The Operation of the chuck and the feeding of stock are controlled by quick running cams, driven by shafts which maintain a constant speed, thus insuring rapid movements irrespective of the size of the work. These cams are controlled by adjustable dogs which are easy of access and easily adjusted. The lead and cross slide cams are steel or cast iron disks, which can be cheaply formed and quickly placed in position. Instructions and diagrams for laying out cams are sent with each machine.

The Feeding Mechanism feeds any length to 4", and, by adjusting the extra dogs furnished with the machine, the stock can be fed forward any length to 15".

The Cross Slide Tools are on separate slides, so that one or both can be used as desired.

Tables, giving the proper speed for different sizes and kinds of stock are sent with each machine.

The Counter-shaft has tight and loose pulleys 10" in diameter for 3 1-4" belt, and should run about 400 revolutions per minute.

Weight of machine ready for domestic shipment, about 1620 lbs.; for foreign shipment, about 1920 lbs.

Net Weight, about 1380 lbs. **Floor Space**, 25" x 60".

Dimensions of boxes in which machine is shipped, 62" x 28" x 28", and 73" x 27" x 24".

Price includes spring collet and feeding finger, set of cam blanks, change gears for making from 40 to 600 pieces per hour, 2 wire stands and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

For Tools and Attachments, see pages 172 to 187.

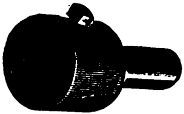
DIE HOLDERS FOR USE ON SCREW MACHINES.

[illegible]

[illegible]	Diameter	Thickness	Price.
[illegible]	5-8	1-4	$4 50
[illegible]	5-8	1-4	5 00
	Cutters & Blank Sizes.		
[illegible]	A 1-4 x 5-8	B 1-4 x 13-16	5 00
[illegible]	B 1-4 x 13-16	C 5-16 x 1	6 00
[illegible]	C 5-16 x 1	D 1-2 x 1 1-2	8 00
[illegible]	D 1-2 x 1 1-2	E 5-8 x 2	14 00
[illegible]	D 1-2 x 1 1-2	E 5-8 x 2	15 00
[illegible]	E 5-8 x 2	F 11-16 x 2 1-2	20 00
[illegible]	B 1-4 x 13-16	C 5-16 x 1	5 00
[illegible]	B 1-4 x 13-16	C 5-16 x 1	6 00
[illegible]	B 1-4 x 13-16	C 5-16 x 1	6 00
[illegible]	C 5-16 x 1	D 1-2 x 1 1-2	6 00
[illegible]	C 5-16 x 1	D 1-2 x 1 1-2	8 00

When ordering, give diameter of holes in turret.

TAP HOLDERS FOR USE ON SCREW MACHINES.



The Tap Holders in the accompanying table marked "releasing" are for any Screw Machine operated by hand and have an improved clutch mechanism which avoids the hard shock and jar usual with such tools when released. The parts subject to wear are small and easily renewed. All parts are hardened.

No. of Holder.	No. of Machine where used.	Releasing.	Diameter of Hole for Tap or Bushing.	Depth of Hole to Receive Tap.	Length of Body.	Diameter of Shank.	Length of Shank.	Price.
00	00 Automatic	No	No. 5 Taper	5-8"	15-16"	5-8"	1 1-8"	$4 00
00A	00 Automatic	No	1-4"	3-8	1-2	5-8	1 1-8	2 20
00B	00 Automatic	Yes	1-2	1-2	1 1-16	5-8	1 1-8	4 50
10	0 Wire Feed	Yes	1-2	11-16	1 5-16	5-8	1 7-16	4 00
11	1 W. F.; 1 Pl.	Yes	5-8	13-16	1 7-16	3-4	2	5 00
12	2 W. F.; 2 Pl.	Yes	1	1 3-16	2	1	2 1-2	7 00
13		Yes	1	1 3-16	2 1-2	1 1-4	3 1-4	10 00
14	4, 5 & 6 Plain	Yes	1	1 3-16	2 1-2	1 1-2	3 1-4	10 00
16	4, 5 & 6 Plain	Yes	1 1-2	1 5-8	2 7-8	1 1-2	3 1-4	15 00
20	0 Automatic	No	5-8	13-16	1 7-16	3-4	1 1-2	4 50
21	1 Automatic	No	3-4	15-16	1 1-2	1	1 3-4	5 00
22	2 Automatic	No	1	1 3-16	1 9-16	1	1 3-4	5 00
22B	2 Automatic	Yes	1	1 3-16	2	1	1 3-4	7 00

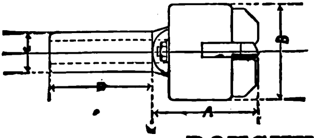
When ordering, give diameter of holes in turret.

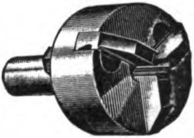
HOLLOW MILLS

With Inserted Blades.

These Mills, for use in the turrets of screw machines, are of great advantage in making a large range of work, as screws, bolts, pins, etc., and work of a similar class.

The holders are of steel, and the slots for receiving the blades are milled accurately to size. The blades are held firmly in position by a simple clamping device, which is operated by nuts at the back of head.





ROUGHING.

Each holder is furnished with one set of blades (3) of any regular size required.

No. of Mill.	Price with one Set of Blades.	Price of extra Blades per Set.	Capacity.	Length of Body and Blades. A	Dia. Outside. B	Dia. Shank. C	Length Shank. D	Number of Machine where used.
			In.	In.	In.	In.	In.	
*00	$6 00	$1 50	.03 to $\frac{1}{4}$	1	$1\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{16}$	**00 Automatic.**
1	11 00	3 00	$\frac{3}{16}$ to $\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$	$\frac{3}{4}$	2	**1 Pl., '97, & 1 W. F.**
3	12 00	3 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	1	$2\frac{1}{2}$	2 Pl., '97, & 2 W. F.
4	12 00	3 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	$1\frac{1}{16}$	$3\frac{1}{4}$	4 & 5 Pl., prior to '96.
5	12 00	3 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	$1\frac{1}{4}$	$3\frac{1}{4}$	6 Pl., prior to '96.
6	14 00	4 00	$\frac{1}{2}$ to $1\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{1}{4}$	**4, 5 & 6 Pl., '96.**

Blades turn large as follows: 1-4″ to 7-16″ about .012; 1-2″ to 3-4″ about .016″; 13-16″ to 1 1-8″, about .02″.

Blades for Nos. 3, 4 and 5 interchange.

When ordering, give diameter of holes in turret.

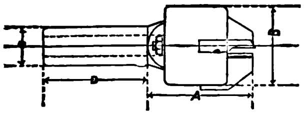
Set of blades turn one size only.

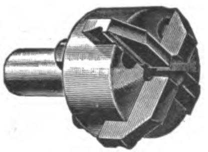
*One set of blades turn all sizes within capacity.

See opposite page for Finishing Mills.

HOLLOW MILLS

With Inserted Blades.





FINISHING.

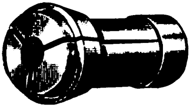
The Finishing Mills have 2 blades and 2 back rests which will turn any size within the capacity of the mill.

No. of Mill.	Price of Mill Complete.	Price of 4 Blades & 2 Back Rests.	Capacity.	Length of Body and Blades. A	Dia. Outside. B	Dia. Shank. C	Length Shank. D	Number of Machine where used.
			In.	In.	In.	In.	In.	
*100	$7 00	$2 00	.03 to $\frac{1}{4}$	1	$1\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{16}$	00 Automatic.
11	13 00	4 00	$\frac{3}{16}$ to $\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$	$\frac{3}{4}$	2	1 Pl., '97, & 1 W. F.
13	14 00	4 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	1	$2\frac{1}{2}$	2 Pl., '97, & 2 W. F.
14	14 00	4 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	$1\frac{1}{16}$	$3\frac{1}{4}$	4 & 5 Pl., prior to '96.
15	14 00	4 75	$\frac{1}{4}$ to $\frac{3}{4}$	$3\frac{1}{4}$	3	$1\frac{1}{4}$	$3\frac{1}{4}$	6 Pl., prior to '96.
16	16 00	5 00	$\frac{1}{2}$ to $1\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{1}{4}$	4, 5 & 6 Pl., '96.

Two extra blades are included in "Price of Mill Complete." As the blades wear much faster than the back rests it is more economical to use the blades alternately.
Blades for Nos. 13, 14 and 15 interchange.
*One set of blades turn all sizes within capacity.
When ordering, give diameter of holes in turret.

SPRING COLLETS AND FEEDING FINGERS

FOR AUTOMATIC AND WIRE FEED SCREW MACHINES.



Spring Collet.

Feeding Finger.

No. 00 Automatic.

	Price Each.
SPRING COLLETS.	
Round: 1-16", 3-32", 1-8", 5-32", 3-16", 7-32", 1-4", 9-32", 5-16"	$2 00
Square or Hexagonal, made to order	4 00
Metric, Round: 2 m/m to 8 m/m, varying by 1 m/m	2 00
FEEDING FINGERS.	
Round: 1-16", 3-32", 1-8", 5-32", 3-16", 7-32", 1-4", 9-32", 5-16"	1 00
Square or Hexagonal, made to order	2 00
Metric, Round: 2 m/m to 8 m/m, varying by 1 m/m	1 00

No. 0 Automatic and No. 1 Wire Feed.

SPRING COLLETS.	
Round: 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2"	$2 50
Square: 1-4", 5-16", 3-8"	4 00
Hexagonal: 1-4", 5-16", 3-8", 7-16"	4 00
Metric, Round: 6 m/m to 12 m/m, varying by 1 m/m	2 50
FEEDING FINGERS.	
Round: 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2"	1 50
Square: 1-4", 5-16", 3-8"	2 25
Hexagonal: 1-4", 5-16", 3-8", 7-16"	2 25
Metric, Round: 6 m/m to 12 m/m, varying by 1 m/m	1 50

No. 1 Automatic.

SPRING COLLETS.	
Round: 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2", 9-16", 5-8"	2 75
Square: 1-4", 5-16", 3-8", 7-16"	4 25
Hexagonal: 1-4", 5-16", 3-8", 7-16", 1-2"	4 25
Metric, Round: 6 m/m to 16 m/m, varying by 1 m/m	2 75
FEEDING FINGERS.	
Round: 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2", 9-16", 5-8"	1 50
Square: 1-4", 5-16", 3-8", 7-16"	2 25
Hexagonal: 1-4", 5-16", 3-8", 7-16", 1-2"	2 25
Metric, Round: 6 m/m to 16 m/m, varying by 1 m/m	1 50

List continued on next page. Other sizes made to order.

SPRING COLLETS AND FEEDING FINGERS—Continued.

No. 2 Automatic.

SPRING COLLETS.		Price Each.
Round:	1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2", 17-32", 9-16", 19-32", 5-8", 11-16", 3-4", 13-16", 7-8", 15-16", 1" . .	3 00
Square:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", ...	4 50
Hexagonal:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", 3-4", 13-16"	4 50
Metric, Round:	10 m/m to 25 m/m, varying by 1 m/m.	3 00
FEEDING FINGERS.		
Round:	1-4", 9-32", 5-16", 11 32", 3-8", 13-32", 7-16", 15-32", 1-2", 17-32", 9-16", 19-32", 5-8", 11-16", 3-4", 13-16", 7-8", 15-16", 1", . . .	1 75
Square:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", ...	2 50
Hexagonal:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", 3-4", 13-16", ...	2 50
Metric, Round:	10 m/m to 25 m/m, varying by 1 m/m.	1 75

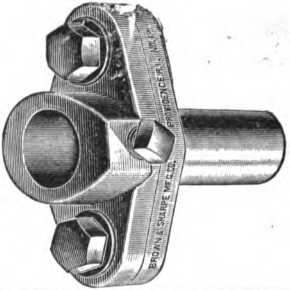
No. 0 Wire Feed.

SPRING COLLETS.		
Round:	1-8", 5-32", 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8"	2 50
Square:	3-16", 1-4"	4 00
Hexagonal:	1-4", 5-16"	4 00
Metric, Round:	4 m/m to 10 m/m, varying by 1 m/m.	2 50
FEEDING FINGERS.		
Round:	1-8", 5 32", 3-16", 7-32", 1-4", 9-32", 5-16", 11-32", 3-8"	1 50
Square:	3-16", 1-4"	2 25
Hexagonal:	1-4", 5-16"	2 25
Metric, Round:	4 m/m to 10 m/m, varying by 1 m/m.	1 50

No. 2 Wire Feed.

SPRING COLLETS.		
Round:	1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2", 17-32", 9-16", 19-32", 5-8", 11-16", 3-4", 13-16", 7-8"	3 00
Square:	3-8", 7-16", 1-2", 9-16"	4 50
Hexagonal:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", 3-4" .	4 50
Metric, Round:	10 m/m to 20 m/m, varying by 1 m/m.	3 00
FEEDING FINGERS.		
Round:	1-4", 9-32", 5-16", 11-32", 3-8", 13-32", 7-16", 15-32", 1-2", 17-32", 9-16", 19-32", 5-8", 11-16", 3-4", 13-16", 7-8"	1 75
Square:	3-8", 7-16", 1-2", 9-16"	2 50
Hexagonal:	3-8", 7-16", 1-2", 9-16", 5-8", 11-16", 3-4" .	2 50
Metric, Round:	10 m/m to 20 m/m, varying by 1 m/m.	1 75

Other sizes made to order.



FLOATING HOLDERS.

For Use on Screw Machines

For Drills, Reamers, Counterbores, &c.

The holder and shank are separate and after a tool is adjusted central with the work, the two are clamped together.

No.	No. of Machine where used.	Diam. of Hole for Drill or Bushing.	Depth of Hole.	Length of Body.	Diam. of Shank.	Length of Shank.	Price.
00	00 Auto.	5 Taper 1-2"	5-8"	15-16"	5-8"	1 1-8"	$3 00
10	0 Wire Feed	1-2"	11-16	29-32	5-8	1 7-16	3 00
12	2 Wire Feed 2 Plain	1	1 3-16	1 1-2	1	2 1-2	4 00
14	4, 5 & 6 Plain	1	1 3-16	1 9-16	1 1-2	3 1-4	4 50
16	4, 5 & 6 Plain	1 1-2	1 5-8	2 5-32	1 1-2	3 1-4	5 00
20	1 Wire Feed 1 Plain 0 Auto.	5-8	13-16	1 1-8	3-4	2	3 50
21	1 Auto.	3-4	15-16	1 1-4	1	1 3-4	3 50
22	2 Auto.	1	1 3-16	1 1-2	1	1 3-4	4 00

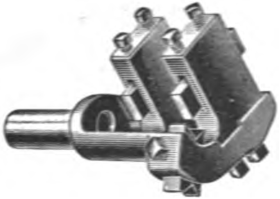
DRILL HOLDERS.

For Use on Screw Machines.

No.	No. of Machine where used.	Diam. of Hole for Drill or Bushing.	Depth of Hole.	Length of Body.	Diam. of Shank.	Length of Shank.	Price.
00	00 Auto.	5 Taper 1-2"	5-8"	15-16"	5-8"	1 1-8"	$1 75
10	0 Wire Feed	1-2"	11-16	1	5-8	1 7-16	2 00
11	1 Wire Feed 1 Plain	5-8	13-16	1 1-8	3-4	2	2 00
12	2 Wire Feed 2 Plain	1	1 3-16	1 5-8	1	2 1-2	3 00
14	4, 5 & 6 Plain	1	1 3-16	1 3-4	1 1-2	3 1-4	3 50
16	4, 5 & 6 Plain	1 1-2	1 5-8	2 1-4	1 1-2	3 1-4	4 00
20	0 Auto.	5-8	13-16	1 7-16	3-4	1 1-2	2 00
21	1 Auto.	3-4	15-16	1 5-16	1	1 3-4	2 50
22	2 Auto.	1	1 3-16	1 9-16	1	1 3-4	3 00

BOX TOOLS

For Use on Screw Machines.



No.	No. of Machine where used.	Diam. that can be turned.	Length that can be turned.	Length of Body.	Diam. of Shank.	Length of Shank.	Price.
00	00 Auto.	1-4"	1"	1 3-8"	5-8"	1 1-8"	$ 8 00
00B	00 Auto.	1-4	1	3-4	5-8	1 3-4	4 50
10	0 Wire Feed	3-8	1 3-4	2 3-16	5-8	1 7-16	12 00
11	1 Wire Feed, 1 Plain	1-2	2 1-4	2 11-16	3-4	2	14 00
12	2 Wire Feed, 2 Plain	3-4	2 3-4	3 3-8	1	2 1-2	16 00
13		1	3	3 3-4	1 1-4	3 1-4	20 00
14	4 Wire Feed	1 1-4	4 1-2	5 3-8	1 1-2	3 1-4	22 00
16	6 Plain	1 1-2	5	5 5-8	1 1-2	3 1-4	25 00
20	0 Auto.	1-2	1 3-4	2 3-16	3-4	1 1-2	10 00
20B	0 Auto.	5-16	1 3-4	2 3-16	3-4	1 1-2	9 00
21	1 Auto.	1-2	2	2 5-8	1	1 3-4	14 00
22	2 Auto.	7-8	2 1-2	3	1	2	14 00

POWER FEEDS

For the Turret Slides of Screw Machines.

Power Feeds for the Turret Slides of Nos. 3, 4 and 5 Plain Screw Machines (see pages 140 to 143) and No. 2 Wire Feed Screw Machine (see page 151), are made and applied to machines when required.

Price, Power Feed for No. 2 Wire Feed, $85 00.

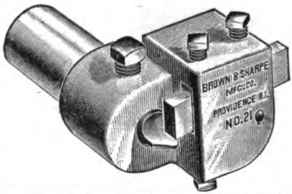
Price, Power Feed for No. 3 Plain, $50 00.

Price, Power Feed for Nos. 4 or 5 Plain, $75 00.

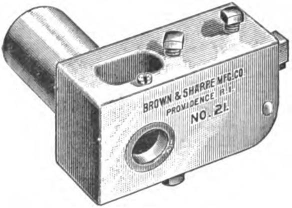
Extra Screw Leaders and Nuts for Nos. 3 or 5 Plain Screw Machines, United States or Metric Standard, are made to order.

CENTERING AND FACING TOOLS.

For Use on Screw Machines.



No.	No. of Machine where used.	Diam. of Drill.	Length of Body.	Diam. of Shank.	Length of Shank.	Price.
00	00 Automatic	1-4″	1 3-8″	5-8″	1 3-8″	$4 00
10	0 Wire Feed	5-16	1 9-16	5-8	1 7-16	7 00
11	1 Wire Feed; 1 Plain 0 Automatic.	3-8	1 11-16	3-4	2	5 00
14	4, 5 & 6 Plain	7-8	2 3-4	1 1-2	3 1-4	12 00
22	2 Wire Feed; 2 Plain; 2 Automatic 1 Automatic	5-8	1 3-4	1	2 3-4	8 00



POINTING TOOLS.

For Use on Screw Machines

For Pointing the Ends of Studs, Screws, &c.

The work runs in a bushing and the end is finished by an end cutting tool made the same shape as the point, and can be repeatedly sharpened by grinding without changing its form.

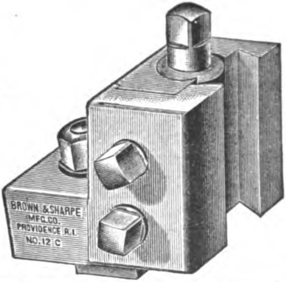
Each tool is provided with blades and bushings, varying by 1-16″ between the sizes given in the table.

No.	No. of Machine where used.	Capacity.	Length of Body.	Distance front of Bushing to Tool.	Diam. of Shank.	Length of Shank.	Price.
00B	00 Auto.	3-16″	11-16″	3-16″	5-8″	1 3-16	$5 00
00C	00 Auto.	1-4	13-16	5-16	5-8	1 5-16	5 50
10	0 Wire Feed	1-8 to 3-8	7-8	3-8	5-8″	1 7-16	10 00
11	1 Wire Feed 1 Plain	3-16 to 1-2	1	7-16	3-4	2	12 00
12	2 Wire Feed 2 Plain	1-4 to 3-4	1 1-4	9-16	1	2 1-2	15 00
16	4, 5 & 6 Plain	1-2 to 1 1-8	1 1-2	5-8	1 1-2	3 1-4	22 00
21	1 Auto.	3-16 to 1-2	1	7-16	1	1 3-4	12 00

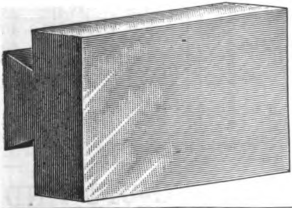
FORMING TOOL HOLDER.

FOR USE

On Front of Cross-Slides of Screw Machines.



No.	Machine where used.	Width of Tool.	Thickness of Tool.	Price.
10 A	No. 0 Wire Feed	1"	1-2"	$8 00
10 B	No. 0 Wire Feed	1 1-4	1-2	8 00
11 B	No. 1 Wire Feed; No. 1 Plain	1 1-4	9-16	10 00
11 C	No. 1 Wire Feed; No. 1 Plain	1 3-4	9-16	10 00
12 C	No. 2 Wire Feed; Nos. 2, 4 & 5 Plain	1 3-4	3-4	12 00
12 E	No. 2 Wire Feed; Nos. 2, 4 & 5 Plain	2 3-4	3-4	12 00
16 D	No. 6 Plain	2 1-2	1	14 00
16 F	No. 6 Plain	4	1	14 00

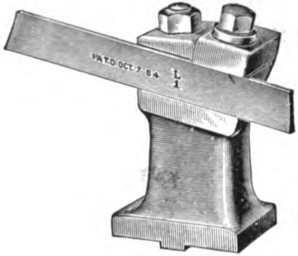


FORMING TOOL BLANKS.

For Use in Above Tool Holders.

No.	Width.	Thickness.	Length.	Price.
10 A	1"	1-2"	1 1-2"	$1 00
10 B	1 1-4	1-2	1 1-2	1 25
11 B	1 1-4	9-16	2	1 25
11 C	1 3-4	9-16	2	1 50
12 C	1 3-4	3-4	2 7-16	1 50
12 E	2 3-4	3-4	2 7-16	2 00
16 D	2 1-2	1	2 7-8	2 00
16 F	4	1	2 7-8	2 50

CUTTING-OFF TOOL POSTS.



For Thin Blade Tools.

For Use on the Back of Cross-Slides of Screw Machines.

No.	Machine where used.	Height from Cross Slide to Centre of Spindle.	Price.	For Post No.	Extra Blades. Thickness.	Extra Blades. Wdth	Price Each.
*00	00 Automatic	1"	$4 00	00	1-32", 1-16", 3-32", 5-64",	1-2"	$0 40
10	0 Wire Feed	1 9-16	5 50	10	1-16", 3-32", 1-8",	11-16	40
11	1 Wire Feed; 1 Plain	2 1-16	6 00	11 12 & 16	1-16", 3-32", 1-8",	13-16	30
12	2 Wire Feed; 2 & 4 Plain	2 1-2	6 50		5-32".	13-16	35
					3-16",	13-16	40
16	6 Plain	2 15-16	7 00		7-32",	13-16	45
					1-4",	13-16	50
*20	0 Automatic	1 5-16	5 00	20	1-16", 3-32", 1-8",	11-16	40
*22	2 Automatic	1 7-16	7 00	22	1-16", 3-32", 1-8",	11-16	40

*In ordering specify whether Front or Rear Post is wanted.

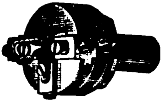
COMBINATION CUTTING-OFF AND KNURLING TOOL POSTS

For Screw Machines.

No.	Machine where used.	Height from Cross-Slide to Centre of Spindle.	Price.
10	No. 0 Wire Feed	1 9-16"	$8 50
11	No. 1 Wire Feed; Nos. 2 & 4 Plain	2 1-16	9 00
12	No. 2 Wire Feed; Nos. 2 & 4 Plain	2 1-2	9 50

TAPER TURNING TOOLS.

For Use on Screw Machines.



These Tools are of advantage in making a large range of work, as taper pins and work of a similar class.

The holders are of steel, have one turning tool, and two back rests, which are operated by a taper guide on the cross slide of the machine. The amount of taper is regulated by the taper on the guide.

When the proper taper is obtained the tool and back rests are withdrawn radially from the work, thus preventing tool marks on the finished product.

The tool and back rests each have separate means of adjustment.

When more abrupt tapers than 1-4" to the foot are required, two tools should be used, one for roughing and the other for finishing.

No. of Holder.	Machine where used.	Dimensions of Head.		Dimensions of Shank.		Largst Dia. that can be Turned.	Price.
		Diam.	Length.	Diam.	Length.		
00	00 Auto.	1 1-2"	1 1-4"	5-8"	1 1-2"	5-16"	$25 00
20	0 Auto.	2	1 1-2	3-4	2	1-2	28 00
22	2 Auto.	2 1-2	1 13-16	1	2 1-4	3-4	28 00

Prices do not include Adjustable Guides.

SETS OF TOOLS FOR USE ON SCREW MACHINES.

These Tools are shipped with each machine. If not wanted, please pack carefully and return by express, at our expense. If the whole set is not wanted, those that are kept will be charged for at the prices given with each tool.

No. 0 Wire Feed Screw Machine.

Set of 4 Spring Collets, one each, 1-8″, 3-16″, 1-4″, 5-16″.
Set of 4 Feeding Fingers, one each, 1-8″, 3-16″, 1-4″, 5-16″.

No. 10 Die Holder.	No. 10 Drill Holder.
No. 10 Tap Holder.	No. 10 Floating Holder.
No. 10 Box Tool.	No. 10 Cutting-off Tool Post.

Price, $39 00.

No. 1 Wire Feed Screw Machine.

Set of 4 Spring Collets, one each, 1-4″, 5-16″, 3-8″, 7-16″.
Set of 4 Feeding Fingers, one each, 1-4″, 5-16″, 3-8″, 7-16″.

No. 11 Die Holder.	No. 20 Floating Holder.
No. 11 Tap Holder.	No. 1 Roughing Hollow Mill.
No. 11 Box Tool.	No. 11 Finishing Hollow Mill.
No. 11 Drill Holder.	

Price, $57 00.

No. 2 Wire Feed Screw Machine.

Set of 8 Spring Collets, one each, 3-8″, 7-16″, 1-2″, 9-16″, 5-8″, 11-16″, 3-4″ and 13-16″.
Set of 8 Feeding Fingers, one each, 3-8″, 7-16″, 1-2″, 9-16″, 5-8″, 11-16″, 3-4″ and 13-16″.

	No. 12 Drill Holder.
No. 12 Die Holder.	No. 22 Floating Holder.
No. 12 Tap Holder.	No. 3 Roughing Hollow Mill.
No. 12 Box Tool.	No. 13 Finishing Hollow Mill.

Price, $75 00.

No. 4 Wire Feed Screw Machine.

No. 14 Die Holder.	No. 14 Floating Holder.
No. 14 Tap Holder.	No. 6 Roughing Hollow Mill, with 3-4″ Blade.
No. 14 Box Tool.	
No. 14 Drill Holder.	No. 16 Finishing Hollow Mill.

Price, $69 00.

No. 6 Plain Screw Machine.

8 Sets Chuck Jaws from 3-8″ to capacity of machine.

No. 16 Die Holder.	No. 16 Floating Holder.
No. 16 Tap Holder.	No. 6 Roughing Hollow Mill, with 3-4″ Blade.
No. 16 Box Tool.	
No. 16 Drill Holder.	No. 16 Finishing Hollow Mill.

Price, $95 00.

TOOLS AND ATTACHMENTS

FOR

No. OO AUTOMATIC SCREW MACHINE,

No. OO AUTOMATIC TURRET FORMING MACHINE.

	Price.
Back Rest for Turret,	$4 50
Back Rest for Turret, long,	4 50
Box Tool, No. 00,	8 00
Box Tool, No. 00B,	4 50
Box Tool for Special Work,	$8 00 to 20 00
Box Tool with Centre Drill,	8 50
Cams, Set complete,	3 00 to 15 00
Cam Blanks, Set of 3 bored and turned,	1 00
Centering and Facing Tool,	4 00
Cutting-off and Forming Tools, Circular,	$2 00 to 9 00
Cutting-off and Forming Tool Blanks, 1-4", 3-8", 1-2" thick,	45
Cutting-off Tool Post for Thin Blade Tools, No. 00,	4 00
Die Holder, No. 00,	4 50
Die Holder, Opening,	25 00
Die Holder, No. 00B, Releasing,	5 00
Dies, 1-2 dozen, one size,	5 50
Drilling Attachment, 1 Spindle,	12 00
Drilling Attachment, 2 Spindles,	18 00
Drilling Attachment for Drill, Tap or Die,	20 00
Drill Holder,	1 75
Drill Holder Bushings, for Drills and Taps,	1 00
Drill Holder Bushing Blanks,	25
Drill Holder with Guide Bushing,	10 00
Feeding Fingers, Round, any size,	1 00
Feeding Fingers, Square or Hexagonal, any size,	2 00
Feed Tube for 3-8" stock (for brass only),	8 00
Floating Holder, for Drills, Taps, Reamers, &c.,	3 00
Hollow Mill, any size,	1 00
Hollow Mill Blanks,	20
Knurl Holder for Turret,	12 00
Knurl Holder for Cross-slide, side,	3 00
Knurl Holder for Cross-slide, top,	5 00
Oiling Arrangement for Turret Tools,	10 00
Pointing Tool Holder for Circular Tools,	6 00
Pointing Tool, Circular,	2 00
Pointing Tool, No. 00B,	5 00
Pointing Tool, No. 00C,	5 50
Pulley, 6" diameter for Counter-shaft to run Spindle half speed in one direction,	1 50
Spring Collets, Round, any size,	2 00
Spring Collets, Square or Hexagonal, any size,	4 00
Stock Stop for Turret,	25
Swing Tools, No. 00B,	17 00
Swing Tools, No. 00C,	15 00
Taps, 1-2 dozen, one size,	4 00
Tap Holder, No. 00,	4 00
Tap Holder, No. 00B, Releasing,	4 50
Tap Holder, No. 00A, Special, for small Taps and Dies,	2 20
*Taper Turning Tool,	25 00
Taper Turning Tool, Adjustable Guide for,	5 00
Tapping Attachment,	16 00
Tool Post for Square Tools,	8 00

*Price does not include Adjustable Guide.

TOOLS AND ATTACHMENTS

FOR

No. O AUTOMATIC SCREW MACHINE,

No. O AUTOMATIC TURRET FORMING MACHINE.

No. O AUTOMATIC CUTTING-OFF MACHINE.

	Price.
Back Rest for Turret, ...	$5 50
Box Tool, No. 20, ...	10 00
Box Tool for Special Work, ... $10 00 to	22 00
Box Tool, No. 20B, ...	9 00
Cams, Set complete, ... 6 00 to	15 00
Cams, Set of Blanks, bored and turned, Mild Steel,	1 50
Centering and Facing Tool, ...	5 00
Cutting-off and Forming Tools, Circular, . 4 00 to	10 00
Cutting-off and Forming Tool Blanks, Circular, .	60
Cutting-off Tool Posts, No. 20, for Thin Blade Tools,	5 00
Cutting-off Tools, Thin Blades for Posts, . . .	40
Die Holder, No. 20, ...	5 00
Die Holder, Opening, ...	30 00
Die Holder, No. 20B, Releasing, ...	6 00
Dies, 1-2 dozen, one size, ...	6 00
Drill Holder, ...	2 00
Drill Holder Bushings for Drills and Taps, . . .	1 00
Drill Holder Bushing Blanks, ...	25
Drilling Attachment for Drill Tap or Die, . .	28 00
Drilling Attachment with 1 Spindle.	18 00
Drilling Attachment with 2 Spindles. . . .	26 00
Feeding Fingers, Round, any size, ...	1 50
Feeding Fingers, Square or Hexagonal, any size, .	2 25
Feed Tube for 1-2″ stock, ...	6 00
Feed Tube for 9-16″ stock, for Brass only, . .	7 50
Feed Tube and Finger, one piece, ...	9 00
Floating Holder for Drills, Taps, or Counterbores,	3 50
Hollow Mills, any size within capacity of machine,	1 75
Hollow Mill Blanks, ...	25
Knurl Holder for Turret, ...	12 00
Knurl Holder for Cross-Slide, side, ...	4 00
Knurl Holder for Cross-Slide, top, ...	6 00
Oiling Arrangement for Turret Tools, ...	12 00
Pointing Tool Holder for Turret for Circular Tools,	8 00
Pointing Tool, Circular, Blanks, ...	25
Spring Collets, Round, any size, ...	2 50
Spring Collets, Square or Hexagonal, any size, .	4 00
Stock Stop for Turret, ...	25
Tap Holder, No. 20, ...	4 50
Taps, 1-2 dozen, one size, ...	4 00
*Taper Turning Tool, ...	28 00
Taper Turning Tool, Adjustable Guide for, . .	6 00

*Price does not include Adjustable Guide.

TOOLS AND ATTACHMENTS

FOR

No. 1 AUTOMATIC SCREW MACHINE,
No. 1 AUTOMATIC TURRET FORMING MACHINE,
No. 1 AUTOMATIC CUTTING-OFF MACHINE.

	Price.
Back Rest for Turret,	$6 00
Box Tool, No. 21,	14 00
Box Tool, for Special Work,	$10 00 to 18 00
Cams, Set complete,	4 00 to 15 00
Cams, Set of Blanks, bored and turned, Cast Iron,	1 50
Cams, Set of Blanks, bored and turned, Mild Steel,	2 00
Centering and Facing Tool,	8 00
Cutting-off and Forming Tools, Circular,	$3 00 to 8 00
Cutting-off and Forming Tool Blanks, Circular, 3-8" to 7-8" thick,	1 00
Cutting-off Tool Posts for Thin Blade Tools,	7 00
Cutting-off Tools, Thin Blades for Posts, 1-16", 3-32", 1-8" thick,	40
Die Holder, No. 21,	6 00
Die Holder, Opening,	30 00
Dies, 1-2 dozen, one size,	6 00
Drill Holder,	2 50
Drill Holder Bushings for Drills and Taps,	1 00
Drill Holder Bushing Blanks,	30
Drill Holder with Drill Chucks,	6 00
Drill Holder with Guide Bushings,	12 00
Drilling Attachment with 1 Spindle,	22 00
Drilling Attachment with 2 Spindles,	33 00
Drilling Attachment for Drill, Tap or Die,	35 00
Feeding Fingers, Round, any size,	1 50
Feeding Fingers, Square or Hexagonal, any size,	2 25
Feed Tube for 3-4" stock (for brass only),	10 00
Floating Holder, for Drills, Taps, Counterbores, Reamers, &c.,	3 50
Floating Holder with Drill Chucks,	9 00
Hollow Mills, any size,	2 00
Hollow Mill Blanks,	40
Knurl Holder for Turret,	15 00
Knurl Holder for Cross-Slide,	5 00
Oiling Arrangement for Turret Tools,	15 00
Pointing Tool for Turret, No. 21, Straight, 6 Blades,	12 00
Pointing Tool Holder for Turret for Circular Tools,	8 00
Pointing Tool, Circular,	2 50
Spring Collets, Round, any size,	2 75
Spring Collets, Square or Hexagonal, any size,	4 25
Stock Stop for Turret,	30
Tap Holder, No. 21,	5 00
Taps, 1-2 dozen, one size,	4 00

TOOLS AND ATTACHMENTS
FOR
No. 2 AUTOMATIC SCREW MACHINE,
No. 2 AUTOMATIC TURRET FORMING MACHINE.

	Price.
Back Rest, Adjustable V,	$6 00
Box Tool, No. 22,	14 00
Box Tool, Special,	$14 00 to 25 00
Cams, Set complete,	4 00 to 20 00
Cams, Set of Blanks, bored and turned, Cast Iron,	1 50
Cams, Set of Blanks, bored and turned, Mild Steel,	2 50
Centering and Facing Tool,	8 00
Cutting-off and Forming Tools, Circular,	$3 00 to 25 00
Cutting-off and Forming Tool Blanks, Circular, 3-8" to 3-4" thick,	1 00
Cutting-off and Forming Tool Blanks, Circular, 7-8" to 1 1-4" thick,	1 50
Cutting-off Tool Posts, No. 22, for Thin Blade Tools,	7 00
Cutting-off Tools, Thin Blades for Posts,	40
Die Holder, No. 22,	6 00
Die Holder, Opening,	30 00
Die Holder, Opening, Set of Chasers for,	1 50
Die Holder, No. 22B, Releasing,	8 00
Dies, 1-2 dozen, one size,	6 00
Drill Holder,	3 00
Drill Holder Bushings for Drills and Taps,	1 00
Drill Holder Bushings, Blanks,	30
Drilling Attachment with 1 Spindle,	22 00
Drilling Attachment with 2 Spindles,	33 00
Drilling Attachment for Drill, Tap or Die,	35 00
Feeding Fingers, Round, any size,	1 75
Feeding Fingers, Square or Hexagonal, any size,	2 50
Floating Holder for Drills, Taps or Counterbores,	4 00
Hollow Mills, any size,	2 00
Hollow Mill Blanks,	40
Knurl Holder for Turret,	15 00
Knurl Holder for Cross-Slide, side,	5 00
Knurl Holder for Cross-Slide, top,	8 00
Oiling Arrangement for Turret Tools,	15 00
Pointing Tool for Turret, Straight, 6 Blades,	15 00
Pointing Tool Holder for Turret for Circular Tools,	10 00
Pointing Tool, Circular,	2 50
Spring Collets, Round, any size,	3 00
Spring Collets, Square or Hexagonal, any size,	4 50
Stock Stop for Turret,	30
Tap Holder, No. 22,	5 00
Tap Holder, No. 22B, Releasing,	7 00
Taps, 1-2 dozen, any size,	4 00
*Taper Turning Tool,	28 00
Taper Turning Tool, Adjustable Guide for,	7 50

*Price does not include Adjustable Guide.

SCREW SLOTTING ATTACHMENTS

For Nos. 00, 0 and 2 Automatic Screw Machines.

This attachment will take screws as they are left by the machine and slot them automatically, thus doing away with an extra machine for slotting and wholly completing the screw on one machine in practically the same time that is required to complete the screw without slotting.

The saw is mounted on a slide and driven by a round belt from the overhead works. It can be adjusted for the depth of cut by means of a screw on the back of the slide.

The screws are held in a bushing carried in a floating holder mounted in an adjustable swinging arm. It is operated by cams that are adjustable on the shaft and provide for slotting almost any screw within the capacity of the machine.

After the attachment is properly adjusted the arm will, usually, need no further adjustment for different widths of slots, except that obtained by the screw bearing against the stop.

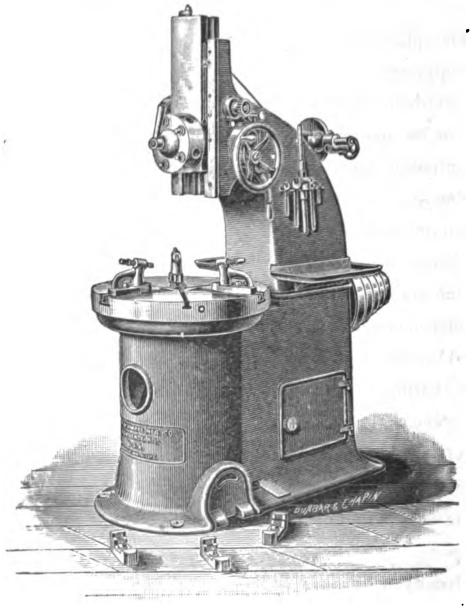
Usually it is more satisfactory to have the attachment fitted to the machine before it is shipped.

Prices, Attachment fitted to the Machine. For No. 00 Machine, $ for No. 0 Machine, $ for No. 2 Machine. $

No. 1

26 in. x 12 in.

VERTICAL CHUCKING MACHINE.



This machine takes work to 26″ in diameter with 12″ face, or to 28″ in diameter with 11″ face, and bores a hole to 11″ in depth.

No. 1

26 in. x 12 in.

VERTICAL CHUCKING MACHINE.

The Chuck Table is revolved by a bevel gear and pinion driven by a cone pulley having 5 steps for 2 1-2" belt, giving, with 2 speeds on counter, 10 changes of speed. It is provided with 3 slides having T slots 5-8" wide, graduated on top to aid the operator in placing the jaws equally distant from centre. When adjusted the jaws can be tightened or loosened by a wrench as in the case of a universal chuck. In addition to the T slots in slides there are 3 others, 5-8" wide. It has a hole 2 1-4" in diameter leading to the pan for collecting chips.

A Brake that can be applied by the foot of the operator is used to stop the table quickly.

The Turret has 5 holes 1 1-2" in diameter and can be clamped in position. Distance from centre, of holes to slide 2". An adjustable dog withdraws the locking pin at any part of the upward movement of slide.

The Turret Slide has an automatic feed of 16", driven by a friction disk and can be quickly changed from 0 to .049" to one revolution of table. In addition to the regular hand feed, a find hand feed, which can be engaged by a friction clutch, is provided. The greatest distance from end of slide to top of table is 23 3-8", the least, 7 3-8". The slide is counterbalanced by a weight inside of column and has a quick hand return movement.

The End of the Upright is 14 1-8" from top of table.

The machine bores a hole 11" deep in work to 26" in diameter with 12" face, or 28" in diameter with 11" face.

The Counter-shaft has two friction pulleys 14" and 16" in diameter for 3 1-2" and 4" belts and should run about 350 and 125 revolutions per minute.

Weight of machine ready for shipment, about 3675 lbs.

Net Weight, about 3000 lbs

Floor Space, 28" x 63".

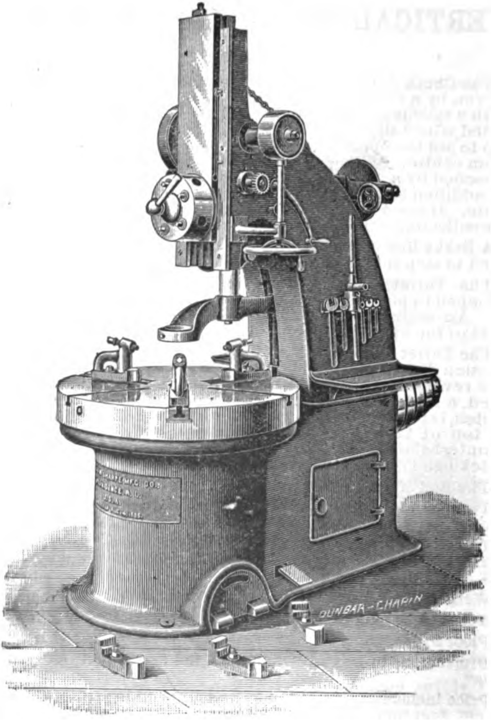
Dimensions of box in which machine is shipped, 69" x 34" x 78".

Price includes 2 sets of jaws, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

Set of Tools for 1 3-8" hole, Price, $

No. 2
36 in. x 14 1-2 in.
VERTICAL CHUCKING MACHINE.



This machine takes work to 36″ in diameter with 14 1-2″ face, and bores a hole to 14 1-2″ in lepth.

No. 2

36 in. x 14 1-2 in.

VERTICAL CHUCKING MACHINE.

The Chuck Table is revolved by a bevel gear and pinion driven by a cone pulley having 5 steps for 3" belt, giving, with 2 speeds on counter, 8 changes of speed. It is provided with 3 slides, having T slots 3-4" wide, graduated on top to aid the operator in placing the jaws equally distant from centre. When adjusted the jaws can be tightened or loosened by a wrench as in the case of a universal chuck. In addition to the T slots in slides there are 3 others, 3-4" wide. It has a hole 3 1-2" in diameter leading to the pan for collecting chips.

A Brake that can be applied by the foot of the operator is used to quickly stop the table.

The Turret has 5 holes 1 3-4" in diameter and can be clamped in position. Distance from centre of holes to slide, 2 1-4". An adjustable dog withdraws the locking pin at any part of the upward movement of slide.

The Turret Slide has an automatic feed of 19 1-2", driven by a friction disk and can be quickly changed from 0 to .056" to one revolution of table. A fine hand feed, which can be engaged by a friction clutch, is also provided. Greatest distance from end of slide to top of table, 32 1-4"; least, 12 3-4". The slide is counter-balanced by a weight inside of column and has a quick hand return movement.

The End of the Upright is 17" from top of table.

A Tool Guide, for the purpose of supporting tools in making heavy cuts, is furnished with the machine.

The machine bores a hole 14 1-2" deep in work to 36" in diameter with a 14 1-2" face.

The Counter-shaft has 2 friction pulleys 16" and 18" in diameter for 4" and 4 1-2" belts and should run about 210 and 105 revolutions per minute.

Weight of machine ready for shipment, about 5585 lbs.

Net Weight, about 4591 lbs.

Floor Space, 36" x 78".

Dimensions of boxes in which machine is shipped, 82"x 41" x 35" and 57"x 36"x 65".

Price includes 2 sets of jaws, and everything else shown in cut, together with overhead works, boxed and delivered f. o. b. at Providence, R. I.

Price, $

Set of Tools for 1 15-16" hole. Price, $

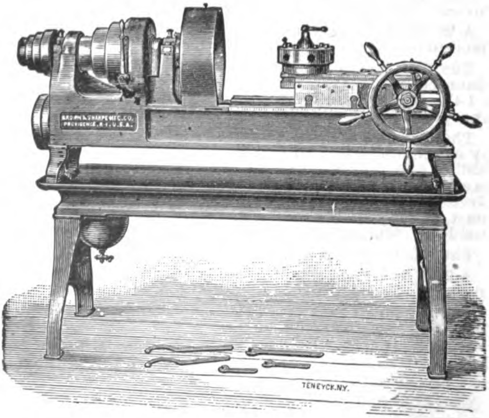
Set of Tools for 1 1-4" hole. Price, $

13 3-8 in. x 8 in.

HORIZONTAL CHUCKING MACHINE.

Back Geared.

Patented October 15, 1889; May 23, 1893; July 24, 1894.



This machine swings 13 3-8″ over bed and bores a hole to 8″ in depth. Greatest distance between turret and end of spindle, 21″.

13 3-8 in. x 8 in.

HORIZONTAL CHUCKING MACHINE.

The Spindle is of steel; the bearings are hardened, ground and lapped and run in phosphor bronze boxes. The front box is provided with means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are of hardened steel and phosphor bronze.

The Hole through spindle is 1 9-16" in diameter.

The Cone has 3 steps for 3" belt and is back geared. The back gears are under spindle and, together with the gears on cone, are enclosed. These gears run continuously and are engaged or disengaged by a clutch, operated by a lever on the front of the machine.

The Turret has 7 holes 1 1-2" in diameter and can be clamped in position. Distance from centre of holes to top of slide, 2 3-4". Greatest distance between turret and end of spindle, 21".

The Feed of turret slide is automatic, and has 8 changes, varying from .035" to .030" to one revolution of spindle. The feed cones have 4 steps, and by operating a lever each of the four speeds of cones can be made fast or slow, without changing the belt.

Swing over bed, 13 3-8". Depth that can be drilled, 8".

The Tank Table has a reservoir cast in the bottom, providing for the collection of the strained oil.

The Counter-shaft has 2 friction pulleys, 14" in diameter for 3 1-2" belts, and should run about 175 revolutions per minute.

Weight of machine ready for domestic shipment, about 2250 lbs.

Weight of machine ready for foreign shipment, about 2400 lbs.

Net Weight, about 1850 lbs.

Floor Space 30" x 86".

Dimensions of boxes in which machine is shipped, 74" x 28" x 32" and 75" x 26" x 20".

Price includes everything shown in cut, together with overhead works boxed and delivered f. o. b. at Providence, R. I.

Price, $

An Oil Pump, pipes, etc., are furnished when desired.

Price, $

9 Inch
UNIVERSAL HAND LATHE.

This lathe swings 9″ over bed and takes 14 1-2″ between centres.

9 Inch
UNIVERSAL HAND LATHE.
With or Without Brake.

The Spindle is of steel, hardened, ground and lapped. The boxes are of bronze, and the front box has means of compensation for wear. The thrust is taken at rear end of spindle; the bearing parts are hardened and ground. It has a hole 1-2" in diameter its entire length. The front end has a special taper hole, and a collet, having this taper on the outside and a No. 8 taper hole inside, is furnished with each lathe.

A 1-4" Self-Adjusting Shell Chuck is sent with each machine. It is made the same taper as the hole in spindle and at the outer end is longitudinally split into three parts. A spring under a sleeve draws the chuck back into spindle and closes it on the work; the sleeve is free to move under the action of the spring and is connected with the chuck by a screw. The upper end of a forked lever spans the sleeve and the lower end is carried under the table and is operated by the knee of the workman.

The Foot-stock Spindle is operated by a hand lever and can be securely fastened by a clamp screw. It has No. 3 taper hole.

The Tool Holder and guides provide for the making of small studs, screws, etc., either straight or taper, in duplicate.

The Lathe swings over bed, 9"; over tool rest, 5 3-4", and takes 14 1-2" between centres.

The Counter-Shaft has tight and loose pulleys 6" in diameter for 2" belt, and should run about 300 revolutions per minute.

Weight of Lathe ready for domestic shipment, about 500 lbs; for foreign shipment, about 650 lbs.

Net Weight, about 425 lbs.

Floor Space, 25"x53".

Dimensions of box in which machine is shipped, 49"x26" x26".

Price includes 1-4" shell chuck, collet for head-stock spindle, tool holder, face plate, tool rest, wrenches, etc., and overhead works, boxed and delivered f. o. b. at Providence, R.I.

Price $

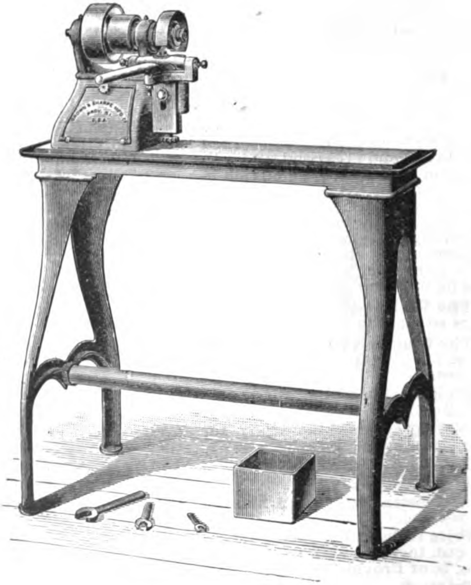
A Slide Rest, $, and a **Centre Rest, $** are furnished when desired.

Shell Chucks from 1-16" to 3-8" inclusive, varying by 32nds of an inch, are kept in stock. Price, each, $ Intermediate sizes, as well as chucks holding disks, are made to order. Chucks are interchangeable with Screw Polishing and Finishing Machines.

This Lathe furnished fitted with brake similar to Polishing and Finishing Machine when desired. Price, $

Low Tables, fitted for two lathes, furnished when desired. **Price, $** **Extra.**

SCREW SLOTTING MACHINE.



This machine slots screws to 5-8″ in diameter, 8 1-2″ in length.

SCREW SLOTTING MACHINE.

The Spindle runs in bronze boxes provided with means of compensation for wear. It is hollow and has a No. 7 taper hole. Arbors are held by a bolt passing through rear end of spindle. A guard is placed over front end of spindle.

The Cone has 2 steps for 2 1-4" belt.

The Jaws are fitted to receive hardened steel split bushings admitting studs and screws to 5-8" in diameter and 3 1-2" in length to be slotted.

The Table is 36" long, 9" wide, and placed on short legs so that the operator can sit while at work.

The Machine is Operated by moving the lever horizontally to open the jaws for inserting the studs and screws and then downward to bring them against the cutter which is kept in motion. A stop screw governs the depth of slot.

The Counter-shaft has tight and loose pulleys 6" in diameter for 2 3-4" belt and should run about 160 revolutions per minute.

Weight of machine ready for domestic shipment, about 440 lbs.

Weight of machine ready for foreign shipment, about 500 lbs.

Net Weight, about 375 lbs.

Floor Space, 28" x 40".

Dimensions of box in which machine is shipped, 48" x 28" x 20".

Price includes 1-2" bushing for jaws, 1" cutter arbor, No. 12 Screw Slotting Cutter, wrenches and overhead works, boxed and delivered f. o. b. at Providence, R. I.

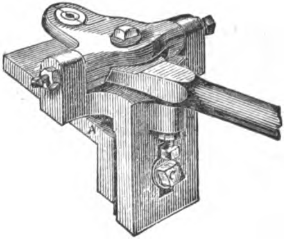
Price, $

Cutter Arbors made to order.

Hardened steel split bushings made to order. In ordering state diameter of screw to be slotted in thousandths of an inch, or if gauge numbers are used, specify the gauge.

For Screw Slotting Cutters, see page 242.

SCREW SLOTTING DEVICE.



The above cut illustrates a Screw Slotting Device that can be attached to a Hand Lathe, and the Device can be quickly and easily operated.

The Jaws are fitted to receive hardened steel split bushings admitting studs and screws to 5-8" in diameter. Greatest distance from top of bushing in jaw to top of knee, 3 3-4".

The Device is Used by clamping the knee A to bed of Hand Lathe by a bolt, the lever projecting in front at right angles with bed. An arbor carrying a Screw Slotting Cutter is held between the centres of Lathe. The lever is moved horizontally to open the jaws for inserting the studs and screws and then downward to bring them against the cutter which is kept in motion. The stop screw B governs the depth of slot. The working part of the Device can be raised or lowered on the knee and clamped by means of bolt, C.

Price includes 1-2" bushing for jaws, 1" screw slotting cutter arbor, No. 12 screw slotting cutter, and wrenches.

Price, $15 00.

Hardened Steel Split Bushings made to order. In ordering state diameter of screw to be slotted in thousandths of an inch, or if gauge numbers are used, specify the gauge.

For screw Slotting Cutters see page 242.

IMPROVED BENCH CENTRES.

8 in. x 36 in.

These Centres swing 8" in diameter and take 36" in length.

The Head and Foot-stock Spindles are of steel, hardened, ground and accurately fitted. The foot-stock centre is held firmly in contact with the work by a stiff spring, and, as the spindle is quickly operated by a lever, work can be easily placed in position and removed. Provision is made for clamping the foot-stock spindle when desired.

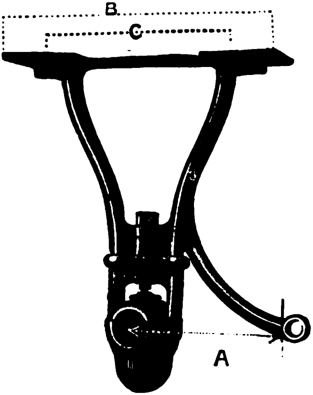
The Indicator is supported by a sliding rest, which is adjustable longitudinally on the bed. The sleeve which carries the arm can be clamped at any height on the post, or turned round the post to bring the arm on either side. The arm turns in the sleeve and may be set at any angle relative to the base, or may be inverted so that the point brought in contact with the work will be over instead of under the work. The movement of this point is magnified a number of times by the length of the index finger. Provision is made for adjusting the finger to zero and for compensation for wear of the points of the pins upon which the finger swings. The graduations read to thousandths of an inch. The Indicator can also be furnished to read to 1-50th of a mm.

A Work Support is furnished.

All the parts are movable on the bed and are clamped in position by screws provided with fixed handles, thus dispensing with wrenches.

Weight, ready for shipment, about 195 lbs.
Net Weight, about 100 lbs.
Dimensions of box for shipment, 54"x 12"x 13".
Price, $
Price, without Indicator, $

SELF-OILING HANGERS.



The above cut represents a Hanger which is provided with a receptacle for oil for the purpose of lubricationg the bearings, the oil being fed to the same by capillary attraction. This hanger is made with or without arms and with one end of the drip closed or both ends open. Light hangers can be furnished with 1"x 4" or 1 1 4"x 4 1-2" boxes.

Heavy hangers with 1 1-2"x 6", or 1 5-8"x 6 1-2" boxes.

Extra heavy hangers with 2"x 8", 2 3-16"x 9", or 2 7-16"x 10" boxes.

LIGHT.

Drop.	Distance from centre of Shaft to Shipper Rod. A	Extreme Width. B	Distance between Centres of Bolt Holes C	Diameter of Holes.	Single Hanger.	Pair of Hangers.
10"	No arm.	16"	12 1-8"	3-4"	$1 75	
10	"A"=7 9-16"	"	"	"	2 00	$4 00
10	"A"=8 5-16	"	"	"	2 00	4 00
12	No arm.	"	"	"	1 75	
12	"A"=7 9-16	"	"	"	2 00	4 00
12	"A"=8 5-16	"	"	"	2 00	4 00
12	"A"=9 7-16	"	"	"	2 00	4 00
12	"A"=10 9-16	"	"	"	2 00	4 00
16	No arm.	"	"	"	2 00	
16	"A"=7 9-16	"	"	"	2 25	4 50
16	"A"=8 5-16	"	"	"	2 25	4 50
16	"A"=9 7-16	"	"	"	2 25	4 50
17	No arm.	"	"	"	2 00	
18	No arm.	"	"	"	2 00	

SELF-OILING HANGERS.

Heavy.

Drop.	Distance from Centre of Shaft to Shipper Rod. A	Extreme Width. B	Distance between Centres of Bolt Holes. C	Diam. of Holes.	Single Hangers	Pair of Hangers
12"	No arm.	16"	12 1-8"	7-8"	$2 75	
12	9 7-16	"	"	"	3 00	$6 00
12	11 5-16	"	"	"	3 00	6 00
12	9 7-16 & 11 7-16	"	"	"	3 00	6 00
12	11 5-16 & 13 1-16	"	"	"	3 00	6 00
16	No arm.	"	"	"	3 00	
16	9 7-16	"	"	"	3 25	6 50
16	11 1-16	"	"	"	3 25	6 50
16	11 1-16 & 13 1-16	"	"	"	3 25	6 50

Extra Heavy.

16	No arm.	22"	18"	1 1-8"	8 00	
16	12 9-16	"	"	"	8 50	17 00
16	12 9-16 & 14 9-16	"	"	"	8 50	17 00

Two Shipper Rod Stops, one Shipper Dog, and two Belt Guides, accompany each pair of Hangers with Arms.
Special Discount given when ordered in large lots.
Descriptive Circular mailed on application.

COUNTER-SHAFTS

With Friction Pulleys and Hangers with Self-Oiling Boxes.

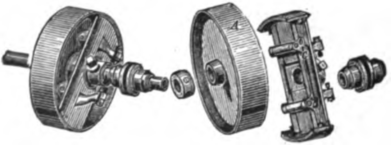
These Counter-Shafts are for driving Milling Machines Screw Machines, Lathes, etc.

The price includes the Shaft, one pair of Patent Self-Oiling Friction Pulleys, page 206. Hangers with self-oiling boxes, page 204. Shipper Rod, Forks and Stops, and a Stud for attaching Shipper Handle.

With Friction Pulleys. Diameter.	Length of Shaft in Clear bet. Hangers.	Diameter of Shaft.	Diameter of Bearing.	Price.
8"	26"	1 1-4"	1"	$15 00
10	33	1 1-4	1	19 00
12	33	1 1-2	1 1-4	22 00
14	33	1 1-2	1 1-4	24 00
16	44	1 11-16	1 1-2	30 00
18	44	1 11-16	1 1-2	34 00

SELF-OILING FRICTION PULLEYS.

Patented May 19, 1885.



We have in our works a large number of these pulleys. They are simple in construction and noiseless when in use. Friction is applied in the most effective manner, as the pads act directly on the rims of the pulleys. The centre oil pocket is an important feature. All the parts are easily adjusted to compensate for wear.

Each pair of pulleys has one thimble and two collars; each single pulley has one thimble and one collar.

Price List of Pulleys Carried in Stock.

Diam.	Belt.	Hole.	Price per Pair.	Price Each.
8"	2 1-4"	1 1-4"	$9 00	$5 00
10	3	1 1-4	13 00	7 00
12	3 1-2	1 1-2	15 00	8 00
14	3 1-2	1 1-2	17 00	9 00
16	4	1 11-16	20 00	10 50
18	4 1-2	1 11-16	24 00	12 50

Space on Shaft required to Operate Friction Pulleys.

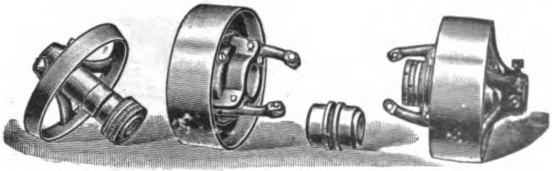
Diam. of Pulley.	Single Pulley.	Pair of Pulleys.
8"	9 7-8"	15 3-4"
10	11 7-8	19 3-4
12	13 5-16	21 11-16
14	13 5-8	22 3-8
16	14 1-2	24
18	15	25

Highest speed at which these Pulleys can satisfactorily be run.

8"	450 rev. per minute.		14"	275 rev. per minute.	
10	375 " " "		16	250 " " "	
12	325 " " "		18	225 " " "	

SELF-OILING FRICTION PULLEYS.

Design of 1895.



These pulleys are designed for high speed and hard service, and are furnished with our Wire Feed Screw Machines.

The pulley runs on the hub of the inner friction surface, and is provided with a ring oiler, which amply lubricates the bearing when the pulley is running idle.

Each pair of pulleys and each single pulley is furnished with one thimble.

Dia.	Belt.	Size of Hole.	Weight.	Price Single Pulley.	Price per Pair.
8"	2 1-2"	1 1-4" or 1 1-2"	23 lbs.	$8 00	$15 00
10	3	1 1-2 or 1 11-16	37 lbs.	10 00	19 00
12	3 1-2	1 1-2 or 1 15-16	59 lbs.	12 00	23 00
14	4	1 11-16 or 1 15-16	74 lbs.	14 00	27 00
16	4 1-2	1 11-16 or 2 3-16	93 lbs.	16 00	31 00

Space on Shaft Required to Operate Friction Pulleys.

Diameter.	Single Pulley.	Two Pulleys.	Three Pulleys.
8"	11"	19"	37 1-4"
10	11 1-2	20	38 3 4
12	13 1-2	23 1-2	45
14	14 1-4	25	47 1-2
16	16 1-4	28 1-4	53 1-2

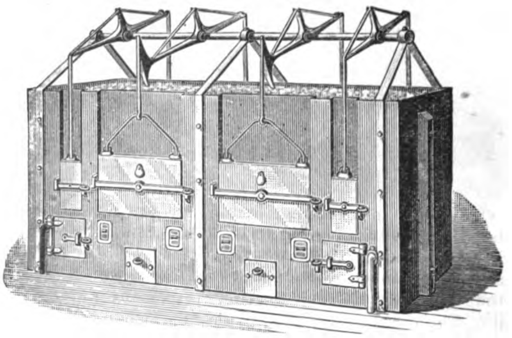
Pulleys with special holes furnished when desired.

Price, single pulley, $1 00 extra. Two or more pulleys, 75 cents each, extra.

It is often desirable to run the spindle of a Screw Machine at different speeds in the same direction; for this purpose we make a special pulley with long levers and special thimble. Three pulleys can thus be operated with one shipper rod.

For price of Special Pulley and Thimble, add $1 00 to the prices given in above list.

CASE HARDENING AND ANNEALING FURNACES.



LEFT HAND. RIGHT HAND.

NO. 2 FURNACE—DOUBLE.

This Furnace is made in two sizes and designed for either Case Hardening or Annealing.

The No. 1 Furnace consumes about 100 lbs. of Lehigh egg coal in 24 hours.

The No. 2 Furnace consumes about 150 lbs. of Lehigh egg coal in 24 hours.

CASE HARDENING AND ANNEALING FURNACES.

These Furnaces may be used either for annealing or case hardening.

Frequently a furnace is used for case hardening during the day, and the heat utilized by using it as an annealing furnace at night.

CONSTRUCTION.

The Outside Casing consists of cast iron plates that are bolted together and also fastened by tie rods that extend through the brick work longitudinally and transversely. The front plates serve as guides for the doors, which are balanced by weights at the back of the furnace, and raised perpendicularly.

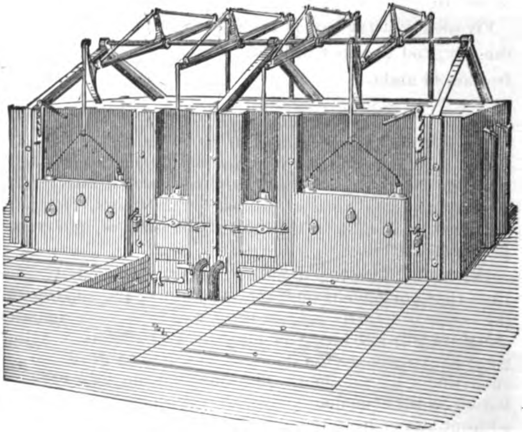
The Doors of the Nos. 1 and 2 Furnaces are about 24 inches from the floor for convenience in handling the small packing boxes ordinarily used in these furnaces. The doors of the No. 4 Furnace swing on hinges. To facilitate handling large packing boxes the doors of Nos. 3 and 4 Furnaces are on a line with the floor. The small "peep hole covers," shown on the oven doors, cover the openings through which, without loss of heat, the interior of the oven may be seen.

Interior. An arch in the interior of the furnace extends over the fire box and oven, which are separated by a bridge wall that rises nearly to the arch. Through the space above this wall the flame from the fire box is forced by the blast, and the gases escape through small outlets at the corners of the ovens to the flues below. These flues are, for the Nos. 1 and 2 Furnaces, 7"x 7"; for the No. 3 Furnace, 6"x 8", and for the No. 4 Furnace, 10"x 10" inside measurements, and are fitted with a damper, which is opened or closed from the front of the furnace.

The Walls of the furnace are built of red brick and lined with fire brick. The arch is built of fire brick. The doors are lined with tile and the oven floors are also tile.

For Dimensions and Prices, see page 213.

CASE HARDENING AND ANNEALING FURNACES.



LEFT HAND. RIGHT HAND.

NO. 3 FURNACE—DOUBLE.

This furnace is made in two sizes and designed for either Case Hardening or Annealing large work.

The No. 3 Furnace consumes about 375 lbs. of Lehigh egg coal in 24 hours.

The No. 4 Furnace consumes about 700 lbs. of Lehigh egg coal in 24 hours.

DIMENSIONS OF CASE HARDENING AND ANNEALING FURNACES.

	No. 1.	No. 2.	No. 3.	No. 4.
Size of Oven, . . .	36″ x 18″ x 10″	51″ x 27″ x 13″	58″ x 34″ x 22″	63″ x 48″ x 29″
Floor Space, Single Oven,	75″ x 55″ x 87″	99″ x 82″ x 108″	98″ x 89″ x 96″	120″ x 106″ x 96″
Floor Space, Double Oven,		99″ x 146″ x 108″	98″ x 165″ x 96″	120″ x 204″ x 96″
Single Furnace, Wght. ready for shipment, Iron work fitted for erection, about	Domestic, 2950 lbs. Foreign, 3100 lbs.	Domestic, 4715 lbs. Foreign, 5190 lbs.	Domestic, 5295 lbs. Foreign, 5375 lbs.	Domestic, 7035 lbs. Foreign, 8050 lbs.
Single Furnace, Wght. ready for shipment, Iron work fitted for erection, with Special Tiles, about	Domestic, 3300 lbs. Foreign, 3470 lbs.	Domestic, 5430 lbs. Foreign, 5900 lbs.	Domestic, 6390 lbs. Foreign, 6470 lbs.	Domestic, 8340 lbs. Foreign, 9355 lbs.
Double Furnace, Wgt. ready for shipment, Iron work fitted for erection, about		Domestic, 7690 lbs. Foreign, 7965 lbs.	Domestic, 9450 lbs. Foreign, 10000 lbs.	Domestic, 10740 lbs. Foreign, 11250 lbs.
Double Furnace, Wgt. ready for shipment, Iron work fitted for erection, with Special Tiles, about		Domestic, 9050 lbs. Foreign, 9325 lbs.	Domestic, 10500 lbs.	Domestic, 13650 lbs. Foreign, 14135 lbs.
Single Furnace. Price, Iron work fitted for erection,	$	$	$	$
Single Furnace. Price, Iron work fitted for erection, with Special Tiles,	$	$	$	$
Double Furnace. Price, Iron work fitted for erection,		$	$	$
Double Furnace. Price, Iron work fitted for erection, with Special Tiles,		$	$	$

Price includes boxing and delivery f. o. b., Providence, R. I.

Case Hardening and Annealing Furnaces can be furnished with ovens from 4 feet 3 inches to 10 feet deep. Prices on application.

In ordering Single Furnaces please state whether right or left-hand are required.

Prices do not include erecting. We will furnish a competent man if de-

Special circular mailed upon application.

CAST IRON PACKING BOXES

FOR

Use in Case-Hardening and Annealing Furnaces.

Pattern Number.	Price.	Length.	Width.	Depth.
1	$0 25	3 3-4″	2″	2″
2	35	3 1-2	3 1-2	3 1-2
3	50	4	4	5 1-2
4	55	5	5	6 1-2
5	75	7	6 1-4	5 1-2
6	95	7	6 1-4	7 1-2
7	80	7 1-2	5 1-4	9
8	60	8	3	6 3-4
9	85	8	3 1-2	9 1-2
10	50	10	3 1-2	3
11	50	10 1-4	4 3-4	3 1-2
12	75	11 1-2	4 3-4	5 1-4
13	1 00	12	6 1-4	5 1-4
14	1 45	11 3-4	6 1-4	6
15	2 00	8 3-4	8 3-4	8
16	2 90	11	11 1-4	9
17	80	14	4 1-2	4
18	3 40	13	9 3-4	7 3-4
19	6 45	15 1-2	14	10
20	3 50	18	9 1-2	9 3-4
21	3 85	20	9	8
22	4 20	28	9	8
	With covers			
23	$10 15	20 3-4	10 1-2	14 1-2
24	18 90	20	13 3-4	20
25	7 90	38 1-2	9 1-2	8
44	1 40	11 3-4	6	7 1-2

ROUND BOXES.

Pattern No.	Price.	Diameter.	Depth.	Weight.
172 A-29	$2 80	15 3-4″	8″	78 lbs.
172 A-32	2 40	12 1-2	7 1-4	68 "

These are all inside measurements. Add 1″ for outside measurements.

In ordering, please give pattern number.

TRUCKS AND DUMPING FORKS,

For use in moving the boxes, filling the ovens, etc., are carried in stock, or can be furnished at short notice.

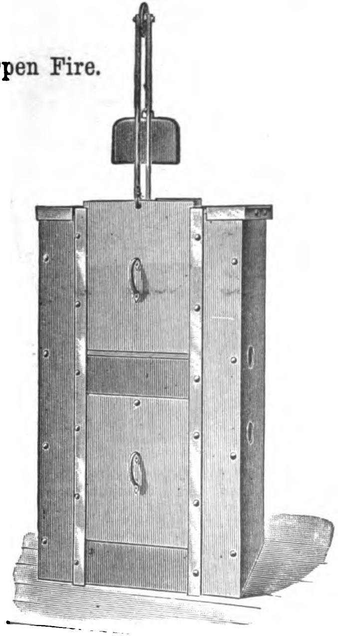
Price, No. 1 Truck, $ **No. 2 Truck, $**

Larger sizes of Trucks made to order.

Dumping Forks, price per lb., **$**

No. 0
SMALL HARDENING FURNACE

For Open Fire.



This Furnace is for use in tempering or heating small pieces for hardening, etc., but is not adapted to case hardening.

The furnace occupies a floor space of 31 1-2″x 36″ and is 56″ high. The door counter-weight runs over a pulley 27 1-2″ above the top of the furnace. The grate is 14″ square. A loose cast iron plate can be placed 4″ over the coals, thus making it the same as a muffler furnace. An air blast can be supplied through a 2 1-2″ pipe.

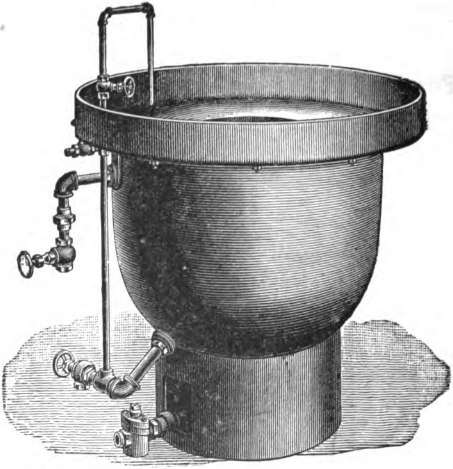
Weight, ready for shipment, about 1208 lbs.

Net Weight, about 1010 lbs.

Dimensions of box for shipment, 62″x 38″x 11″.

Price, $

SODA KETTLE.



This Kettle is used for cleaning or removing grease and dirt from small tools and parts of machines. A coil of steam pipe is employed to heat the water, in which a quantity of soda has been placed, and the pieces immersed in the solution when taken out, dry without rusting.

The Kettles are usually made with round tops and stand in the centre of the room among the machines, but they are also made of a form suitable to place against a wall or in a corner.

Outside Diameter of top plate, 38″; diameter of kettle, 29″; diameter of inside coil of pipe, 24″; height from floor to top of flange, 37″; depth of kettle, 22″; diameter of wire basket or cage for receiving the work, 11″; depth of basket, 16″. Capacity of kettle, about 60 gallons.

A perforated bucket or shaker, 6 1-4″ diameter, 13″ long, is conveniently used in washing small pieces.

Weight for shipment, about 700 lbs.

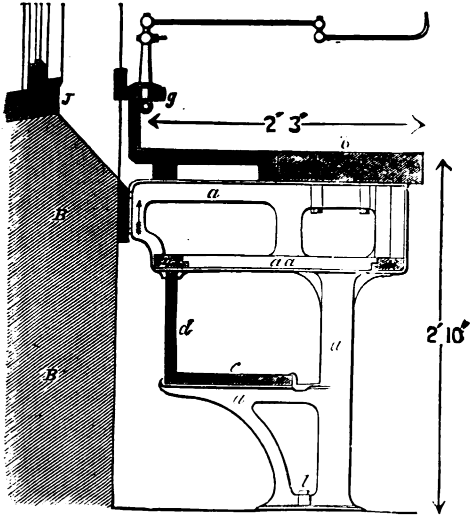
Net Weight, about 550 lbs.

Dimensions of box for shipment, 40″ x 36″ x 41″.

Price includes interior coil of pipe, wire basket, perforated bucket or shaker and the pipe with valves, etc., as shown in cut, boxed and delivered f. o. b. at Providence, R. I.

Price, $

IMPROVED WORK BENCH.



The above cut shows an improved design of Bench for Iron and Wood work. The leg or casting *a* consists of a rigid standard, a bracket for the support of the shelf *c*, and its accompanying back. The legs or standards are fastened to the floor by coach screws, shown at *l*, and are supported at the back by the wall *BB*. They are usually placed about 4 feet apart and support the bench *b*, the shelf *g*, the frame-work *n*, and the shelf *c*, and its accompanying back. The frame-work *n n*, forms a strong support upon which slide the drawers. The shelf *c*, supported by the brackets is held in place by the cast iron clip, shown at the front. The shelf *g*, affords a neat and substantial support for the gas brackets. The front of the leg or standard is provided, at *i*, with a hole to receive the bolt for holding the vise and this construction brings the vise directly over the leg or standard.

We are prepared to furnish complete sets of castings for patterns for the iron work of the above described bench, or castings complete for benches, drilled ready for use.

Circular, giving prices, weight and other information sent on application. Weight of leg casting complete, about 56 lbs.

Drawings, showing construction, sent with orders.

CAST IRON LETTERS.

SIGNS.

These letters make an attractive, simple and durable sign for large buildings. Their size makes them visible at long distances and the beveled edges preserve the correct appearance through a wide range of view.

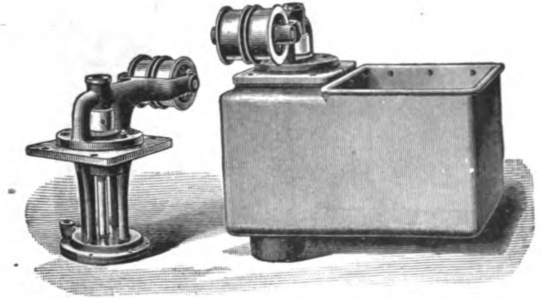
They may be painted to suit the color and situations of the buildings upon which they may be placed. When properly mounted the expense in maintaining these letters is very small as an occasional coat of paint is the only thing required to keep them looking well.

We have full alphabets and full sets of figures of each size. The large letters and figures are 5 feet high. The small letters and figures are 4 feet high.

Special circular and price list, giving full information, mailed on application.

A blue print of detail drawings, showing a method of mounting, is furnished with the letters.

CENTRIFUGAL WATER PUMPS.



No.	Lift.	6 feet.	8 feet.	12 feet.	16 feet.	20 feet.	Discharge.	Net Weight.
	Rev. per Minute.	Capacity, Quarts per Minute.						
2	800	7 qts.	7 qts.	......	......	......	3-8″	40 lbs.
	1000	13 "	6 "	......	......	......		
	1500	24 "	20 "	14 qts.	5 qts.	......		
4	500	8 "	6 "	......	......	......	3-4″	85 lbs.
	750	24 "	16 "	......	......	......		
	1200	96 "	53 "	40 qts.	28 qts.	16 qts.		

Minimum Speed at which No. 2 Pump should run to raise water 4 feet, 800 rpm; No. 4, 500 rpm.

Driving Pulley, No. 2 Pump, 2″ diameter for 1″ belt; No. 4 Pump, 2 3-4″ diameter for 1 1-4″ belt.

These Pumps are for use with water only, and as the bearings do not come in contact with the water, are well adapted for use on grinding or other machines where the water used contains a large amount of emery particles or grit.

The Pump consists of a simple fan revolving in a loose case. The fan revolves in a horizontal plane, and is immersed in the water. By this method the pump is constantly primed, and there is no leak from loose packings.

The Driving Belt, which makes a quarter turn around the idle pulleys, furnished with the pump, can run over the counter-shaft, or can run over pulleys connected with some part of the machine.

The Bracket, which supports the idle pulleys, is held by two bolts that slide in slots, thus allowing the pulleys to be set in any desired position.

Price, No. 2 Pump, $7 00; No. 4 Pump, $18 00.

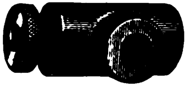
Tank for No. 2 Pump.

A Tank especially designed for use with this Pump, provided with a straining pan and plug to draw off the water can be furnished when desired.

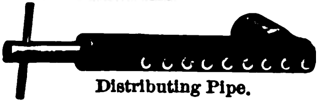
Price, $8 00. Weight, 67 lbs

PUMP ACCESSORIES.

Strainer.

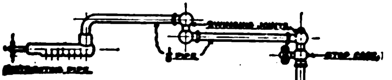


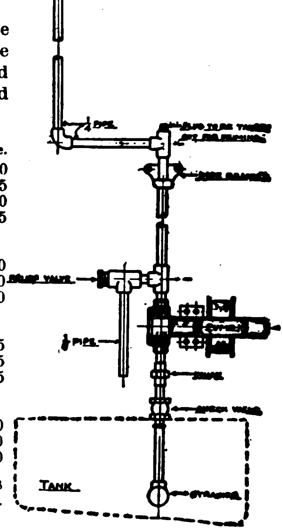
Relief Valve.



Distributing Pipe.

Check Valve.





The following parts, for use with the pumps shown on the preceding pages, are carried in stock and can be furnished when desired.

For Oil Pump.	Price.
No. 2 Distributing Pipe,	$0 50
Check Valve, ...	55
No. 2 Relief Valve, . .	1 00
No. 1 Strainer, ...	35

For No. 1 Geared Pump.	
No. 2 Distributing Pipe,	$0 50
No. 2 Relief Valve, . .	1 00
No. 2 Strainer, ...	50

For No. 3 Geared Pump.	
No. 4 Distributing Pipe,	$0 75
No. 3 Relief Valve, . .	1 25
No. 3 Strainer, ...	75

For No. 11 Geared Pump.	
No. 2 Distributing Pipe,	$0 50
No. 2 Relief Valve, . .	1 00
No. 2 Strainer, ...	50

Other parts are ordinary gas pipe and fittings, and are furnished only when ordered.

7770.

NOTICE.

If 100 or more **Metal Slitting Saws** or **Cutters for Sawing Bicycle Chain Links** of any one size are ordered at one time, we make an extra discount.

Special Prices will be made on Standard Internal and External Cylindrical Gauges and Standard Caliper Gauges when ordered in large quantities. Price list of these Gauges, Pages 325 to 329.

Machine Tools. Prices of Machine Tools, as well as other tools, not given in the catalogue, will be furnished upon application.

Milling Machines. We would call attention to the complete line of these machines, Pages 2 to 45. They show many new features of importance; for example, all Universal, together with corresponding sizes of Plain Milling Machines are fitted with Positive Feeds, Steel Arms clamped with one lever, Telescopic Elevating Screw and other features that make the machines even more accurate and durable than formerly.

The New Method of Indexing, applied to the Universal Milling Machines, admits of all divisions from 1 to 382.

The No. 2-A Universal Milling Machine is an entirely new departure in Milling Machine construction. It is especially well adapted for Motor Drive.

Milling Machine Cutter Arbors. We furnish, in addition to catalogue lists, these Arbors made to Metric Measure.

Standard Gears. The price lists have been omitted in this catalogue. Special Gear Lists mailed upon application.

Machinists' Tools. By the addition of the "B. & S." Combination Squares, Pages 416 to 418; the "B. & S." Protractors, Pages 419, 420, 423; and the "B. & S." Combination Sets, Pages 421 to 423, this line is now exceptionally complete and we invite investigation through the Hardware and Supply Dealers.

Micrometer Calipers. The New Clamp Ring that has been applied to Nos. 4-A, 5-A, 8, 10, 45, 46, 47 and 48, is new in design and recognized by users of Micrometers as much superior to the old style clamp nut. It is unusually efficient and simple in construction. There are no threads to become worn or catch dirt and as only a slight movement of the ring is required to clamp the measuring spindle firmly, there is practically no wear upon the parts.

Gear Cutters. Circular Pitch. These cutters are now listed on Pages 268 and 269. They are not kept in stock but made to order.

We Respectfully Request:

That we be promptly notified of any defects apparent in the workmanship of any of our Machines or Tools.

That all verbal orders and instructions be confirmed in writing.

That all business communications be addressed to the Company.

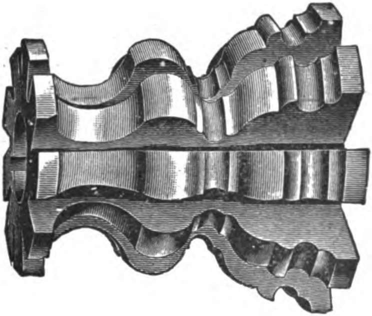
BROWN & SHARPE MFG. CO.

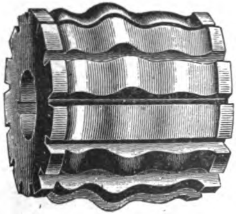
MACHINES AND TOOLS ADDED.

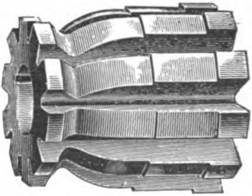
Automatic Cutting-Off Machine. No. 00.
Heavy "B. & S." Combination Sets, Nos. 84, 87, 94 and 97.
Heavy "B. & S." Combination Squares, Nos. 50 and 61.
Heavy "B. & S." Combination Protractors, Nos. 22 and 26.
Micrometer Calipers, Nos. 4-A, 5-A, 83.
Micrometer Caliper, Wooden Handle, for Rolling Mills, No. 17.
Micrometer Caliper, Screw Thread, No. 690.
Morse Taper End Mills.
Morse Taper Spiral End Mills.
New Clamp Ring for Micrometer Calipers, Nos. 4-A, 5-A, 8, 10, 45, 46, 47, 48.
Plain Milling Machines, Nos. 00 **Hand**, 1-B, 2-B, and 13-B.
Screw Pitch Gauge, No. 766.
Screw Slotting Attachment for Nos. 00, 0 and 2, Automatic Screw Machines.
Side Milling Cutters. List added to.
Spring Depth Gauge with Friction, No. 725.
Tempered Steel Shrink Rules. 6″ added.
Thickness Gauge, No. 782.
Universal Depth Gauges, Nos. 711 and 712.
Universal Milling Machine, No. 2-A.
Wire Feed Screw Machine, Roller Feed, No. 4.
Worm Hobs. List added to.

FORMED MILLING CUTTERS

For Milling Sewing Machine and Gun Parts.



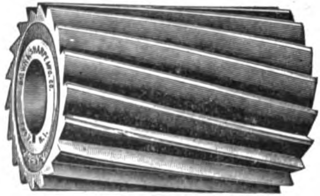




These Cutters can be made in a great variety of outlines and can be sharpened by grinding without changing their form. They are economical in the production of duplicate and interchangeable parts.

In ordering send sketch of, or sample piece to be milled, with size of hole required in cutter.

MILLING CUTTERS.



Cutters of 3-4" face and over, have teeth of a spiral form.
Cutters varying from the following list are made to order, of any required size.

No.	Diameter of Cutter.	Width of Face.	Size of Hole.	Price of each Cutter.
1	2 1-4"	1-2"	7-8"	$1 75
2	2 1-4	1	7-8	2 50
3	2 1-4	1 3-4	7-8	3 30
4	2 1-4	3-16	7-8	1 30
5	2 1-2	3-16	1	1 30
6	2 1-2	1-4	1	1 40
7	2 1-2	5-16	1	1 50
8	2 1-2	3-8	1	1 60
9	2 1-2	7-16	1	1 70
10	2 1-2	1-2	1	1 80
11	2 1-2	9-16	1	1 90
12	2 1-2	5-8	1	2 00
13	2 1-2	11-16	1	2 10
14	2 1-2	3-4	1	2 20
15	2 1-2	13-16	1	2 30
16	2 1-2	7-8	1	2 40
17	2 1-2	1	1	2 60
17A	2 1-2	1 1-8	1	2 75
18	2 1-2	1 1-4	1	2 90
19	2 1-2	1 1-2	1	3 10
20	2 1-2	1 3-4	1	3 40
21	2 1-2	2	1	3 70
21A	2 1-2	2 1-4	1	3 90
22	2 1-2	2 1-2	1	4 10
22A	2 1-2	2 3-4	1	4 25
23	2 1-2	3	1	4 50
24	2 1-2	3 1-2	1	5 00
25	2 1-2	4	1	5 50
25A	2 3-4	3-16	1	1 30
25B	2 3-4	1-4	1	1 50
25C	2 3-4	5-16	1	1 60
26	2 3-4	3-8	1	1 80
27	2 3-4	7-16	1	1 85
28	2 3-4	1-2	1	1 90

List continued on next page.

MILLING CUTTERS—Continued.

No.	Diameter of Cutter.	Width of Face.	Size of Hole.	Price of each Cutter.
29	2 3-4"	9-16"	1"	$2 00
30	2 3-4	5-8	1	2 10
30 A	2 3-4	1	1	3 10
30 C	2 3-4	1 1-8	1	3 25
30 E	2 3-4	1 1-4	1	3 40
30 H	2 3-4	1 1-2	1	3 75
30 M	2 3-4	1 3-4	1	4 00
30 O	2 3-4	2	1	4 20
30 R	2 3-4	2 1-2	1	4 60
30 T	2 3-4	3	1	5 00
30 U	2 3-4	3 1-2	1	5 50
31	2 3-4	4	1 1-4	6 00
31 A	2 3-4	5	1 1-4	7 40
32	2 3-4	6	1 1-4	10 00
33	2 3-4	11-16	1	2 30
34	2 3-4	3-4	1	2 50
35	2 3-4	7-8	1	2 85
36	3	3-16	1	1 35
37	3	1-4	1	1 60
38	3	5-16	1	1 85
39	3	3 8	1 1-4	2 10
40	3	7-16	1 1-4	2 25
41	3	1-2	1 1-4	2 40
42	3	9-16	1 1-4	2 55
43	3	5-8	1 1-4	2 70
44	3	11-16	1 1-4	2 85
45	3	3-4	1 1-4	3 00
46	3	7-8	1 1-4	3 30
47	3	1	1 1-4	3 60
48	3	1 1-4	1 1 4	4 00
49	3	1 1-2	1 1-4	4 30
50	3	1 3-4	1 1-4	4 50
51	3	2	1 1-4	4 70
60	3	2 1-2	1 1-4	5 20
61	3	3	1 1-4	5 40
62	3	3 1-2	1 1-4	5 90
63	3	4	1 1-4	6 40
64	3	5	1 1-4	7 80
65	3	6	1 1-4	10 80
66	3 1-2	3-16	1	1 45
67	3 1-2	1-4	1	1 70
68	3 1-2	5-16	1	2 05
69	3 1-2	3-8	1	2 40
70	3 1-2	7-16	1	2 75
71	3 1-2	1-2	1 1-4	3 15
72	3 1-2	9-16	1 1-4	3 30
73	3 1-2	5-8	1 1-4	3 45
74	3 1-2	11-16	1 1-4	3 65

List continued on next page.

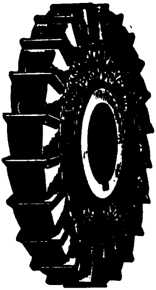
MILLING CUTTERS—Continued.

No.	Diameter of Cutter.	Width of Face.	Size of Hole.	Price of each Cutter.
75	3 1-2"	3-4"	1 1-4"	$3 85
76	3 1-2	7-8	1 1-4	4 35
77	3 1-2	1	1 1-4	4 75
78	3 1-2	1 1-4	1 1-4	5 15
79	3 1-2	1 1-2	1 1-4	5 60
80	3 1-2	1 3-4	1 1-4	6 00
81	3 1-2	2	1 1-4	6 40
82	3 1-2	2 1-2	1 1-4	6 90
83	3 1 2	3	1 1-4	7 40
84	3 1-2	3 1-2	1 1-4	8 15
85	3 1-2	4	1 1-4	9 15
86	3 1-2	5	1 1-4	10 40
87	3 1-2	6	1 1-4	11 90
88	4	1-4	1 1-4	2 00
89	4	5-16	1 1-4	2 50
90	4	3-8	1 1-4	3 00
91	4	7-16	1 1-4	3 50
92	4	1-2	1 1-4	3 90
92 A	4	1-2	1 1-2	3 90
93	4	9-16	1 1-4	4 10
94	4	5-8	1 1-4	4 30
95	4	11-16	1 1-4	4 50
96	4	3-4	1 1-4	4 70
96 A	4	3-4	1 1-2	4 70
97	4	7-8	1 1-4	5 15
98	4	1	1 1-4	5 65
98 A	4	1	1 1-2	5 65
99	4	1 1-4	1 1-4	6 25
99 A	4	1 1-4	1 1-2	6 25
100	4	1 1-2	1 1-4	6 65
100 A	4	1 1-2	1 1-2	6 65
101	4	1 3-4	1 1-4	7 05
101 A	4	1 3-4	1 1-2	7 05
102	4	2	1 1-4	7 45
102 A	4	2	1 1-2	7 45
103	4	2 1-2	1 1-4	8 40
104	4	3	1 1-4	9 00
105	4	3 1-2	1 1-4	10 00
106	4	4	1 1-4	11 00
106 A	4	4	1 1-2	11 00
107	4	5	1 1-4	13 50
107 A	4	5	1 1-2	13 50
108	4	6	1 1-4	15 50
109	4	3	1 1-2	9 00
110	4	6	1 1-2	15 50
111	4 1-2	3-8	1 3-4	3 35
112	4 1-2	3-8	2	3 35
113	4 1-2	7-16	1 3-4	3 75
114	4 1-2	7-16	2	3 75

List continued on next page.

MILLING CUTTERS—Continued.

No.	Diameter of Cutter.	Width of Face.	Size of Hole.	Price of each Cutter.
115	4 1-2"	1-2"	1 3-4"	$4 10
116	4 1-2	1-2	2	4 10
117	4 1-2	9-16	1 3-4	4 40
118	4 1-2	9-16	2	4 40
119	4 1-2	5-8	1 3-4	4 60
120	4 1-2	5-8	2	4 60
121	4 1-2	11-16	1 3-4	4 85
122	4 1-2	11-16	2	4 85
123	4 1-2	3-4	1 3-4	5 10
124	4 1-2	3-4	2	5 10
125	4 1-2	7-8	1 3-4	5 50
126	4 1-2	7-8	2	5 50
127	4 1-2	1	1 3-4	6 00
128	4 1-2	1	2	6 00
129	4 1-2	1 1-4	1 3-4	6 60
130	4 1-2	1 1-4	2	6 60
131	4 1-2	1 1-2	1 3-4	7 25
132	4 1-2	1 1-2	2	7 25
133	4 1-2	1 3-4	1 3-4	8 00
134	4 1-2	1 3-4	2	8 00
135	4 1 2	2	1 3-4	8 75
136	4 1-2	2	2	8 75



SIDE MILLING CUTTERS.

With Inserted Teeth.

The teeth are of tool steel inserted in the periphery of the cast iron body. The bushings, screws and teeth are interchangeable, thus allowing the teeth to be easily adjusted or removed.

The following sizes are carried in stock.

No.	Diameter.	Width of Face.	Hole.	Price Each.
5	6"	2"	1 1-4"	[illegible]
8	7	2	1 1-4	[illegible]
11	8	2	1 1-2	[illegible]
14	9	2	1 1-2	[illegible]
17	10	2	1 1-2	[illegible]

Other sizes made to order. Prices on applicati[illegible]

MILLING CUTTERS

AND

SIDE MILLING CUTTERS

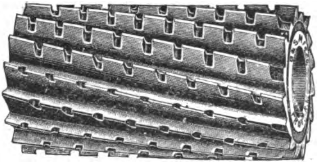
With Inserted Teeth.

Side Milling Cutter. Made to Order. Milling Cutter.

We recommend that Milling Cutters and Side Milling Cutters more than 8″ in diameter, be made with inserted teeth.

The teeth are of tool steel, hardened and inserted in the periphery of the cast iron body. They are held in place by taper bushings and screws, and can thus be easily adjusted or removed.

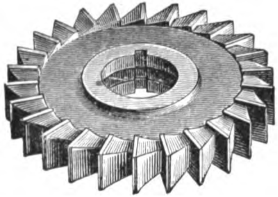
Prices on application.



MILLING CUTTERS WITH Nicked Teeth.

Cutters of this form are especially adapted for the heavier class of milling. The teeth being nicked, the chip is broken up, thus enabling a heavier cut to be taken than would be possible with the ordinary Milling Cutter.

No.	Diameter.	Width of Face.	Hole.	Price.
200	2 1-2″	2 1-2″	1″	$4 90
201	2 1-2	3	1	5 40
202	2 1-2	3 1-2	1	6 00
203	2 1-2	4	1	6 60
204	3	2 1-2	1 1-4	6 25
205	3	3	1 1-4	6 50
206	3	3 1-2	1 1-4	7 10
207	3	4	1 1-4	7 70
208	3	5	1 1-4	9 40
209	3	6	1 1-4	13 00
210	3 1-2	2 1-2	1 1-4	8 25
211	3 1-2	3	1 1-4	8 90
212	3 1-2	3 1-2	1 1-4	9 80
213	3 1-2	4	1 1-4	11 00
214	3 1-2	5	1 1-4	12 50
215	3 1-2	6	1 1-4	14 25
216	4	2 1-2	1 1-4	10 00
217	4	2 1-2	1 1-2	10 00
218	4	3	1 1-4	10 80
219	4	3	1 1-2	10 80
220	4	3 1-2	1 1-4	12 00
221	4	3 1-2	1 1-2	12 00
222	4	4	1 1-4	13 20
223	4	4	1 1-2	13 20
224	4	5	1 1-4	16 20
225	4	5	1 1-2	16 20
226	4	6	1 1-4	18 60
227	4	6	1 1-2	18 60
228	4 1-2	2 1-2	1 3-4	11 50
229	4 1-2	2 1-2	2	11 50
230	4 1-2	3	1 3-4	12 75
231	4 1-2	3	2	12 75
232	4 1-2	3 1-2	1 3-4	14 25
233	4 1-2	3 1-2	2	14 25
234	4 1-2	4	1 3-4	15 75
235	4 1-2	4	2	15 75
236	4 1-2	5	1 3-4	18 75
237	4 1-2	5	2	18 75
238	4 1-2	6	1 3-4	22 25
239	4 1-2	6	2	22 25

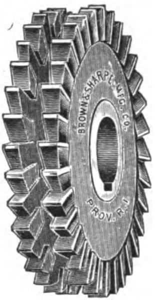


SIDE MILLING CUTTERS.

These cutters are often used in pairs for sizing nuts, bolt heads etc. and are then called "Straddle Mills." They have teeth upon both sides and edges.

No.	Diam.	Width of Face.	Hole.	Price Each.
10	2"	3-16"	1-2"	$2 00
11	2	1-4	1-2	2 05
12	2	3-8	1-2	2 10
13	2	3-16	5-8	2 00
14	2	1-4	5-8	2 05
15	2	3-8	5-8	2 10
16	2 1-2	1-4	7-8	2 15
16 A	2 1-2	5-16	7-8	2 20
17	2 1-2	3-8	7-8	2 20
17 A	2 1-2	7-16	7-8	2 25
18	2 1-2	1-2	7-8	2 25
19	2 3-4	1-4	7-8	2 30
19 A	2 3-4	5-16	7-8	2 30
20	2 3-4	3-8	7-8	2 30
20 A	2 3-4	7-16	7-8	2 35
21	2 3-4	1-2	7-8	2 35
22	3	1-4	1	2 40
22 A	3	5-16	1	2 45
23	3	3-8	1	2 50
23 A	3	7-16	1	2 65
24	3	1-2	1	2 80
24 B	3 1-2	7-16	1	3 50
24 A	3 1-2	1-2	1	3 50
25	3 1-2	9-16	1	3 50
26	3 1-2	5-8	1	3 70
26 A	4	1-2	1	4 00
27	4	5-8	1	4 70
28	4	5-8	7-8	4 70
28 A	4	5-8	1 1-4	4 70
29	4	3-4	1	5 00
29 A	4	7-8	1	5 50
30	5	3-4	1	6 00
30 A	5	3-4	1 1-4	6 00
31	5	7-8	1	6 50
31 A	5	1	1	7 25
31 B	6	3-4	1	7 60
32	6	15-16	1 1-4	8 50
33	6	15-16	1 1-2	8 50
33 A	7	1	1 1-4	16 10
34	7	1 1-8	1 1-4	17 00
34 A	8	1	1 1-4	19 60
35	8	1 3-8	1 1-4	23 00
36	8	1 3-8	1 1-2	23 00
36 A	8	1 3-[illegible]	1 3-4	23 00
37	8	[illegible]	2	23 00

Cutters varying fro[illegible]e made to order.



INTERLOCKING SIDE MILLING CUTTERS.

These Cutters can be easily adjusted for maintaining a standard width of slot.

Unless otherwise ordered they are furnished in pairs.

No.	Diameter.	Total Width of Face.	Hole.	Price.
1	2"	3-8"	1-2"	$4 00
2	2	1-2	1-2	4 10
3	2	3-4	1-2	4 20
4	2	3-8	5-8	4 00
5	2	1-2	5-8	4 10
6	2	3-4	5-8	4 20
7	2 1-2	1-2	7-8	4 30
8	2 1-2	3-4	7-8	4 40
9	2 1-2	1	7-8	4 50
10	2 3-4	1-2	7-8	4 60
11	2 3-4	3-4	7-8	4 60
12	2 3-4	1	7-8	4 70
13	3	1-2	1	4 80
14	3	3-4	1	5 00
15	3	1	1	5 60
16	3 1-2	1 1-8	1	7 00
17	3 1-2	1 1-4	1	7 40
18	4	1 1-4	1	9 40
19	4	1 1-4	7-8	9 40
20	4	1 1-2	1	10 00
21	5	1 1-2	1	12 00
22	5	1 3-4	1	13 00
23	6	1 7-8	1 1-4	17 00
24	6	1 7-8	1 1-2	17 [illegible]
25	7	2 1-4	1 1-4	[illegible]
26	8	2 3-4	1 1-4	[illegible]
27	8	2 3-4	1 1-2	[illegible]

END MILLS.

Left Hand Mill.

In ordering, state whether Right or Left Hand Mills are wanted.

No.	Diameter.	No. of Taper.	Length of Cut.	Whole Length.	Price.
0	1-4"	4	13 16"	2 7-16"	$1 00
1	1-4	5	13-16	3	1 15
2	5-16	4	7-8	2 1-2	1 00
3	5-16	5	7-8	3 1-16	1 15
4	3-8	4	7-8	2 1-2	1 10
5	3-8	5	7-8	3 1-16	1 20
6	7-16	4	15-16	2 9-16	1 10
7	7-16	5	15-16	3 1-8	1 25
8	1-2	5	1	3 3-16	1 30
9	1-2	7	1 1-8	5 1-8	1 45
10	9-16	5	1 1-16	3 1-4	1 35
11	9-16	7	1 1-4	5 1-4	1 50
12	5-8	5	1 1-4	3 7-16	1 45
13	5-8	7	1 1-2	5 1-2	1 70
14	11-16	7	1 1-2	5 1-2	1 75
15	11-16	9	1 1-2	6 3-4	1 90
16	3-4	7	1 5-8	5 5-8	1 80
17	3-4	9	1 5-8	6 7-8	1 95
18	13-16	7	1 5-8	5 5-8	1 90
19	13-16	9	1 5-8	6 7-8	2 00
20	7-8	7	1 3-4	5 3-4	2 10
21	7-8	9	1 3-4	7	2 25
22	15-16	7	1 3-4	5 3-4	2 10
23	15-16	9	1 3-4	7	2 25
24	1	7	1 7-8	5 7-8	2 15
25	1	9	1 7-8	7 1-8	2 30
26	1 1-16	7	1 7-8	5 7-8	2 15
27	1 1-16	9	1 7-8	7 1-8	2 35
28	1 1-8	7	2	6	2 25
29	1 1-8	9	2	7 1-4	2 40
30	1 3-16	7	2	6	2 25
31	1 3-16	9	2	7 1-4	2 50
32	1 1-4	7	2	6	2 25
33	1 1-4	9	2	7 1-4	2 55
34	1 5-16	9	2 1-8	7 3-8	2 75
35	1 3-8	9	2 1-8	7 3-8	2 75
36	1 7-16	9	2 1-4	7 1-2	3 00
37	1 1-2	9	2 1-4	7 1-2	3 00

Morse Taper furnished if required.

4 Taper fits A and J Collets; No. 5, C, D and K Collets;
and E Collets; No. 9, F, G, H, I, S and T Collets.
'lets see page 46. For List of Tapers see page 51.

SPIRAL END MILLS.

Left Hand Mill.

In ordering, state whether Right or Left Hand Mills are wanted.

No.	Diameter.	No. of Taper.	Length of Cut.	Whole Length.	Price.
10	1-2"	5	1"	3 3-16"	$1 30
11	1-2	7	1 1-8	5 1-8	1 45
12	9-16	5	1 1-16	3 1-4	1 35
13	9-16	7	1 1-4	5 1-4	1 50
14	5-8	5	1 1-4	3 7-16	1 45
15	5-8	7	1 1-2	5 1-2	1 70
16	11-16	7	1 1-2	5 1-2	1 75
17	11-16	9	1 1-2	6 3-4	1 90
18	3-4	7	1 5-8	5 5-8	1 80
19	3-4	9	1 5-8	6 7-8	1 95
20	13-16	7	1 5-8	5 5-8	1 90
21	13-16	9	1 5-8	6 7-8	2 00
22	7-8	7	1 3-4	5 3-4	2 10
23	7-8	9	1 3-4	7	2 25
24	15-16	7	1 3-4	5 3-4	2 10
25	15-16	9	1 3-4	7	2 25
26	1	7	1 7-8	5 7-8	2 15
27	1	9	1 7-8	7 1-8	2 30
28	1 1-16	7	1 7-8	5 7-8	2 15
29	1 1-16	9	1 7-8	7 1-8	2 35
30	1 1-8	7	2	6	2 25
31	1 1-8	9	2	7 1-4	2 40
32	1 3-16	7	2	6	2 25
33	1 3-16	9	2	7 1-4	2 50
34	1 1-4	7	2	6	2 25
35	1 1-4	9	2	7 1-4	2 55
36	1 5-16	9	2 1-8	7 3-8	2 75
37	1 3-8	9	2 1-8	7 3-8	2 75
38	1 7-16	9	2 1-4	7 1-2	3 00
39	1 1-2	9	2 1-4	7 1-2	3 00

No. 4 Taper fits A and J Collets; No. 5 C. D and K Collets; No. 7, B and E Collets; No. 9, F [illegible] d T Collets.

For Collets see page 46. Fr [illegible] page 51.

END MILLS WITH CENTRE CUT.

Left Hand Mill.

In ordering, state whether Right or Left Hand Mills are wanted.

These End Mills are useful where it is desired to cut into the work with the end of the mill, and then move along as in cams, grooves, etc., as the teeth are sharp on the inside, and thus cut a path out from the first entering point. They are also useful in taking heavy cuts, especially in cast iron.

No.	Diameter.	No. of Taper.	Length of Cut.	Whole Length.	Price.
50	1-2"	5	1"	3 3-16"	$1 50
51	1-2	7	1 1-8	5 1-8	1 80
52	9-16	5	1	3 1-4	1 70
53	9-16	7	1 1-4	5 1-4	1 85
54	5-8	5	1 1-4	3 7-16	1 80
55	5-8	7	1 1-2	5 1-2	2 10
56	11-16	7	1 1-2	5 1-2	2 15
57	11-16	9	1 1-2	6 3-4	2 35
58	3-4	7	1 5-8	5 5-8	2 25
59	3-4	9	1 5-8	6 7-8	2 45
60	13-16	7	1 5-8	5 5-8	2 35
61	13-16	9	1 5-8	6 7-8	2 50
62	7-8	7	1 3-4	5 3-4	2 60
63	7-8	9	1 3-4	7	2 80
64	15-16	7	1 3 4	5 3-4	2 60
65	15-16	9	1 3-4	7	2 80
67	1	7	1 7-8	5 7-8	2 70
68	1	9	1 7-8	7 1-8	2 85
69	1 1-16	7	1 7-8	5 7-8	2 70
70	1 1-16	9	1 7-8	7 1-8	2 95
71	1 1-8	7	2	6	2 80
72	1 1-8	9	2	7 1-4	3 00
73	1 3-16	7	2	6	2 80
74	1 3-16	9	2	7 1 4	3 10
75	1 1-4	7	2	6	2 80
76	1 1-4	9	2	7 1-4	3 20
77	1 5-16	9	2 1-8	7 3-8	3 45
78	1 3-8	9	2 1-8	7 3-8	3 45
79	1 7-16	9	2 1-4	7 1-2	3 75
80	1 1-2	9	2 1-4	7 1-2	3 75

Morse Taper furnished if required.

No. 4 Taper fits A and J Collets; No. 5, C, D and K Collets; No. 7, B and E Collets; No. 9, F, G, H, I, 8 and T Collets. **For Collets see page 46. For List of Tapers see page 51.**

END MILLS.

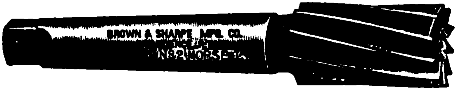
Morse Taper.

In ordering, state whether Right or Left Hand Mills are wanted.

No.	Diameter.	No. of Taper.	Length of Cut	Whole Length.	Price.
100	1-4"	1	13-16"	3 5-8"	$1 15
101	5-16	1	7-8	3 11-16	1 15
102	3-8	1	7-8	3 11-16	1 20
103	7-16	1	15-16	3 3-4	1 25
104	7-16	2	1	4 7-16	1 40
105	1-2	1	1	3 13-16	1 30
106	1-2	2	1 1-8	4 9-16	1 45
107	9-16	1	1 1-16	3 7-8	1 35
108	9-16	2	1 1-4	4 11-16	1 50
109	5-8	2	1 1-2	4 15-16	1 55
110	11-16	2	1 1-2	4 15-16	1 75
111	3-4	2	1 5-8	5 1-16	1 80
112	3-4	3	1 5-8	5 13-16	1 95
113	13-16	2	1 5-8	5 1-16	1 90
114	13-16	3	1 5-8	5 13-16	2 00
115	7-8	2	1 3-4	5 3-16	2 10
116	7-8	3	1 3-4	5 15-16	2 25
117	15-16	2	1 3-4	5 3-16	2 10
118	15 16	3	1 3-4	5 15-16	2 25
119	1	2	1 7-8	5 15-16	2 10
120	1	3	1 7-8	5 5-16	2 35
121	1 1-16	2	1 7-8	6 5 16	2 15
122	1 1-16	3	1 7-8	6 1-16	2 30
123	1 1-8	3	2	5 5-16	2 35
124	1 3-16	3	2	6 1-16	2 40
125	1 1-4	3	2	6 3-16	2 45
126	1 1-4	4	2	6 3-16	2 55
127	1 5-16	3	2 1-8	6 3-16	2 65
128	1 5-16	4	2 1-8	7 1-4	2 75
129	1 3-8	3	2 1-8	6 5-16	2 65
130	1 3 8	4	2 1-8	7 3-8	2 75
131	1 7-16	3	2 1-4	6 7-16	2 75
132	1 7-16	4	2 1-4	7 1 2	3 00
133	1 1-2	3	2 1-4	6 7-16	2 75
134	1 1-2	4	2 1-4	7 1-2	3 00
135	1 5-8	4	2 3-8	7 5-8	3 25
136	1 3-4	4	2 3-8	7 5-8	3 50
137	1 7-8	4	2 1-2	7 3-4	3 75
138	2	4	2 1-2	7 3-4	[illegible]

SPIRAL END MILLS.

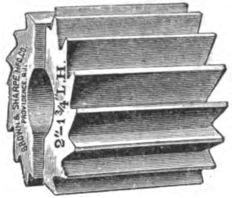
Morse Taper.



In ordering, state whether Right or Left Hand Mills are wanted.

No.	Diameter.	No. of Taper.	Length of Cut.	Whole Length.	Price.
110	1-2″	1	1″	3 13-16″	$1 30
111	1-2	2	1 1-8	4 9-16	1 45
112	9-16	1	1 1-16	3 7-8	1 35
113	9-16	2	1 1-4	4 11-16	1 50
114	5-8	2	1 1-2	4 15-16	1 55
115	11-16	2	1 1-2	4 15-16	1 75
116	3-4	2	1 5-8	5 1-16	1 80
117	3-4	3	1 5-8	5 13-16	1 95
118	13-16	2	1 5-8	5 1-16	1 90
119	13-16	3	1 5-8	5 13-16	2 00
120	7-8	2	1 3-4	5 3-16	2 10
121	7-8	3	1 3-4	5 15-16	2 25
122	15-16	2	1 3-4	5 3-16	2 10
123	15-16	3	1 3-4	5 15-16	2 25
124	1	2	1 7-8	5 5-16	2 15
125	1	3	1 7-8	6 1-16	2 30
126	1 1-16	2	1 7-8	5 5-16	2 15
127	1 1-16	3	1 7-8	6 1-16	2 30
128	1 1-8	3	2	6 3-16	2 35
129	1 3-16	3	2	6 3-16	2 40
130	1 1-4	3	2	6 3-16	2 45
131	1 1-4	4	2	7 1-4	2 55
132	1 5-16	3	2 1-8	6 5-16	2 65
133	1 5-16	4	2 1-8	7 3-8	2 75
134	1 3-8	3	2 1-8	6 5-16	2 65
135	1 3-8	4	2 1-8	7 3-8	2 75
136	1 7-16	3	2 1-4	6 7-16	2 75
137	1 7-16	4	2 1-4	7 1-2	3 00
138	1 1-2	3	2 1-4	6 7-16	2 75
139	1 1-2	4	2 1-4	7 1-2	3 00
140	1 5-8	4	2 3-8	7 5-8	3 25
141	1 3-4	4	2 3-8	7 5-8	3 50
142	1 7-8	4	2 1-2	7 3-4	3 75
143	2	4	2 1-2	7 3-4	4 00

SHELL END MILLS.



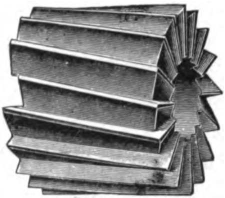
Left Hand Mill.

No.	Diameter.	Length of Cut.	No. of Arbor on which Cutter can be used.	Hole.	Price.
1	1 9-16"	1 3-4"		3-4"	$2 65
2	1 5-8	1 3-4		3-4	2 80
3	1 11-16	1 3-4		3-4	3 00
4	1 3-4	1 3-4		3-4	3 20
5	1 13-16	1 3-4	90	3-4	3 40
6	1 7-8	1 3-4		3-4	3 60
7	1 15-16	1 3-4	94	3-4	3 80
8	2	1 3-4		3-4	4 00
9	2 1-16	1 3-4		3-4	4 25
10	2 1-8	1 3-4		3-4	4 50
11	2 3-16	1 3-4		3-4	4 75
12	2 1-4	2 1-4		1	5 00
13	2 5-16	2 1-4		1	5 25
14	2 3-8	2 1-4		1	5 50
15	2 7-16	2 1-4		1	5 75
16	2 1-2	2 1-4		1	6 00
17	2 9-16	2 1-4	91	1	6 25
18	2 5-8	2 1-4		1	6 50
19	2 11-16	2 1-4	95	1	6 75
20	2 3-4	2 1-4		1	7 00
21	2 13-16	2 1-4		1	7 25
22	2 7-8	2 1-4		1	7 50
23	2 15-16	2 1-4		1	7 75
24	3	2 1-4		1	8 00

In ordering, state whether Right or Left Hand Mills are wanted.

For List of Arbors for use with the above End Mills see page 53.

SPIRAL SHELL END MILLS.



Left Hand Mill.

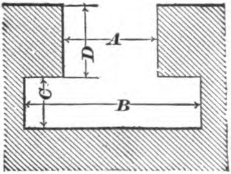
No.	Diameter.	Length of Cut.	No. of Arbor on which Cutter can be used.	Hole.	Price.
1	1 9-16"	1 3-4"		3-4"	$2 65
2	1 5-8	1 3-4		3-4	2 80
3	1 11-16	1 3-4		3-4	3 00
4	1 3-4	1 3-4		3-4	3 20
5	1 13-16	1 3-4	90	3-4	3 40
6	1 7-8	1 3-4		3-4	3 60
7	1 15-16	1 3-4	94	3-4	3 80
8	2	1 3-4		3-4	4 00
9	2 1-16	1 3-4		3-4	4 25
10	2 1-8	1 3-4		3-4	4 50
11	2 3-16	1 3-4		3-4	4 75
12	2 1-4	2 1-4		1	5 00
13	2 5-16	2 1-4		1	5 25
14	2 3-8	2 1-4		1	5 50
15	2 7-16	2 1-4		1	5 75
16	2 1-2	2 1-4		1	6 00
17	2 9-16	2 1-4	91	1	6 25
18	2 5-8	2 1-4		1	6 50
19	2 11-16	2 1-4	95	1	6 75
20	2 3-4	2 1-4		1	7 00
21	2 13-16	2 1-4		1	7 25
22	2 7-8	2 1-4		1	7 50
23	2 15-16	2 1-4		1	7 75
24	3	2 1-4		1	8 00

In ordering, state whether Right or Left Hand Mills are wanted.

For List of Arbors for use with the above End Mills see page 53.

STANDARD T SLOT CUTTERS.

Left Hand Cutter.



In ordering, state whether Right or Left Hand Cutters are wanted.

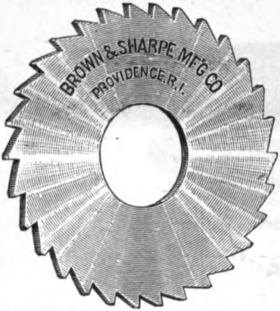
No. of Cutter	Width of Slot A.	Diam. of Neck of Cutter.	Width of Slot B.	Depth C.	Extreme Limit D.	No. of Taper	Price.
4	1-4″	7-32″	1-2″	5-32″	5-16″	4	$1 50
7	1 4	7-32	1 2	5-32	5-16	5	1 60
10	5-16	9-32	5-8	5-32	3-8	5	1 80
13	5 16	9-32	5-8	5-32	3-8	7	2 10
16	3 8	11-32	11-16	7-32	7-16	5	2 00
19	3-8	11-32	11-16	7-32	7-16	7	2 20
22	7-16	3 8	13-16	7-32	7 16	7	2 35
25	7-16	3-8	13-16	7-32	7 16	9	2 50
28	1-2	7-16	15-16	9-32	9-16	7	2 60
31	1-2	7-16	15-16	9-32	9-16	9	2 80
34	5-8	17-32	1 3-16	13-32	11-16	9	3 10
37	3-4	21-32	1 5-16	17-32	1	9	3 45
40	7-8	25-32	1 5-8	11-16	1 1-16	9	3 75
43	1	29-32	1 7-8	13-16	1 3-16	9	4 00

These Cutters are made 1-32″ larger in diameter and in thickness than the figures given, to allow for sharpening.

Other sizes made to order.

For Collets, see page 46. For List of Tapers, see page 51.

METAL SLITTING SAWS.



These are thin MILLING CUTTERS. They are ground on the sides and left a little thicker at the outer edge than near the centre, to give a proper clearance in cutting deep slots.

In ordering *special* saws please state for what purpose they are required.

No.	Diameter.	Thickness.	Hole.	Price.
10	2 1-2″	1-32″	7-8″	$1 00
11	2 1-2	3-64	7-8	1 00
12	2 1-2	1-16	7-8	90
13	2 1-2	3-32	7-8	90
14	2 1-2	1-8	7-8	90
15	2 1-2	5-32	7-8	1 10
16	3	1-32	1	1 25
17	3	3-64	1	1 10
18	3	1-16	1	1 00
19	3	3-32	1	1 00
20	3	1-8	1	1 00
21	3	5-32	1	1 15
22	4	1-32	1	2 25
23	4	3-64	1	1 45
24	4	1-16	1	1 25
25	4	3-32	1	1 20
26	4	1-8	1	1 20
27	4	5-32	1	1 40
28	4	3-16	1	1 60
29	5	1-16	1	1 80
30	5	3-32	1	1 60
31	5	1-8	1	1 50
32	5	1-8	1 1-4	1 50
33	5	1-8	1 1-2	1 50
34	5	5-32	1	1 90
35	5	3-16	1	2 30
36	6	1-16	1	4 00
37	6	3-32	1	3 00
38	6	1-8	1	2 70
39	6	3-16	1 1-2	3 50
40	6	3-16	1	3 50
41	7	1-16	1	7 50
42	7	3-32	1	[illegible]
43	7	1-8	1	[illegible]
44	8	1-8	1	[illegible]

FORMED SAWS

FOR SLITTING COPPER.

Patented July 30, 1895.

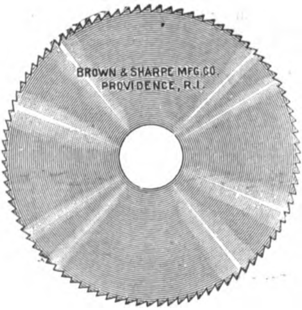
These saws are designed especially for the slitting or sawing of metals that are of a soft or tenacious character, and are superior to the ordinary saw usually employed for this purpose.

The teeth are backed off and formed the same as in all formed milling cutters, and are sharpened by grinding the face, thus retaining the outline of the saw. Each alternate tooth is V shaped and, as the others are flat, the chip is split and forced out sidewise, having less tendency to clog than where the ordinary saw is employed.

The sides of these saws are ground concave for clearance.

These saws are made to order of any desired size.

pon application.



SCREW SLOTTING CUTTERS.

These Cutters have a fine pitch of teeth especially adapted for the slotting of screw heads and similar work.

These Cutters are not ground on the sides.

Diam. of Screw Head to be Slotted.	Thickness of Cutter by Am. Standrd Wire Gauge.	Thickness of Cutter in Decimals.	Diameter of Cutter.	Size of Hole.	Price Each.
	No. 5	.182	2 3-4"	1"	$0 70
	6	.162	2 3-4	1	60
	7	.144	2 3-4	1	50
7-8"	8	.128	2 3 4	3-4 & 1	45
3-4	9	.114	2 3-4	3-4 & 1	40
5-8	10	.102	2 3-4	3-4 & 1	35
	11	.091	2 3-4	3-4 & 1	30
1-2	12	.081	2 3-4	3-4 & 1	25
	13	.072	2 3-4	3-4 & 1	20
3-8	14	.064	2 3-4	1-2, 5-8, 3-4 & 1	20
11-32	15	.057	2 3-4	1-2, 5 8, 3-4 & 1	15
5-16	16	.051	2 3-4	1-2, 5-8, 3-4 & 1	15
9-32	17	.045	2 3-4	1-2, 5-8, 3-4 & 1	15
1-4	18	.040	2 3-4	1-2, 5-8, 3-4 & 1	15
7-32	19	.035	2 3-4	1-2, 5-8, 3-4 & 1	15
3-16	20	.032	2 3-4	1-2, 5-8, 3-4 & 1	15
1-8	21	.028	2 3-4	1-2, 5-8, 3-4 & 1	15
	22	.025	2 3-4	1-2, 5-8, 3-4 & 1	15
	23	.023	2 3-4	1-2, 5-8, 3-4 & 1	15
	24	.020	2 3-4	1-2, 5 8, 3-4 & 1	15
	25	.018	2 3-4	1-2, 5-8, 3-4 & 1	15
	26	.016	2 3-4	1-2, 5-8, 3-4 & 1	15
	27	.014	2 3-4	1-2, 5-8, 3-4 & 1	15
	28	.012	2 3-4	1-2, 5-8, 3-4 & 1	15
	30	.010	2 3-4	1-2, 5-8, 3-4 & 1	15
	32	.008	2 3-4	1-2, 5-8, 3-4 & 1	15
	34	.006	2 3-4	1-2, 5-8, 3-4 & 1	15
3-16	20	.032	2 1-4	1-2, 5-8 & 3-4	15
1-8	21	.028	2 1-4	1-2, 5-8 & 3-4	15
	22	.025	2 1-4	1-2, 5-8 & 3-4	15

SCREW SLOTTING CUTTERS—Continued.

Diam. of Screw Head to be Slotted.	Thickness of Cutter by Am. Standrd Wire Gauge.	Thickness of Cutter in Decimals.	Diameter of Cutter.	Size of Hole.	Price Each.
	No. 23	.023	2 1-4″	1-2, 5-8 & 3-4″	$0 15
	24	.020	2 1-4	1-2, 5-8 & 3-4	15
	25	.018	2 1-4	1-2, 5-8 & 3-4	15
	26	.016	2 1-4	1-2, 5-8 & 3-4	15
	27	.014	2 1-4	1-2, 5-8 & 3-4	15
	28	.012	2 1-4	1-2, 5-8 & 3-4	15
	30	.010	2 1-4	1-2, 5-8 & 3-4	15
	32	.008	2 1-4	1-2, 5-8 & 3-4	15
	34	.006	2 1-4	1-2, 5-8 & 3-4	15
3-8	14	.064	1 3-4	5-8	15
11-32	15	.057	1 3-4	5-8	15
5-16	16	.051	1 3-4	5-8	15
9-32	17	.045	1 3-4	5-8	15
1-4	18	.040	1 3-4	5-8	15
7-32	19	.035	1 3-4	5-8	15
3-16	20	.032	1 3-4	5-8	15
1-8	21	.028	1 3-4	5-8	15
	22	.025	1 3-4	5-8	15
	23	.023	1 3-4	5-8	15
	24	.020	1 3-4	3-8, 1-2 & 5-8	12
	25	.018	1 3-4	3-8, 1-2 & 5-8	12
	26	.016	1 3-4	3-8, 1-2 & 5-8	12
	27	.014	1 3-4	3-8, 1-2 & 5-8	12
	28	.012	1 3-4	3-8, 1-2 & 5-8	12
	30	.010	1 3-4	3-8, 1-2 & 5-8	12
	32	.008	1 3-4	3-8, 1-2 & 5-8	12
	34	.006	1 3-4	3-8, 1-2 & 5-8	12

Cutters varying from the list are made to order.

JEWELERS' SAWS.

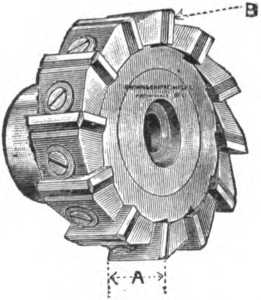
Many of the Screw Slotting Cutters listed above are suitable for Jewelers' use in sawing chain links, etc.

SCREW SLOTTING CUTTER ARBORS.

These Arbors are for use with Screw Slotting Cutters, and are adapted to use on Centres. The following sizes are carried in stock; 3-8″ [illegible] 3-4″, 7-8″, 1″.
Price, each, [illegible]

FACE MILLING CUTTERS

With Inserted Teeth.



Left Hand Cutter.

The cut shows a form of cutter especially adapted for all classes of face milling.

The body is of cast iron, provided with a taper hole and key way and is held firmly in place, on the arbor, by a screw.

The teeth are of tool steel, hardened. They are held in place by taper bushings and screws and can thus be easily adjusted or removed. The bushings, screws and teeth are interchangeable.

No. of Mill.	Size.	Face A.	Face B.	No. of Taper Hole.	No. of Arbor on which Cutter can be used.	Price.
1	5 1-2"	2"	1"	10	79 or 80	$12 00
2	5 1-2	2	1	12	81, 82, 84, 85 or 86	12 00
3	6 1-2	2	1	10	79 or 80	14 00
4	6 1-2	2	1	12	81, 82, 84, 85 or 86	14 00
6	7 1-2	2	1	12	81, 82, 84, 85 or 86	16 00
7	8 1-2	2 3-8	1	12	81, 82, 84, 85 or 86	18 00
8	9 1-2	2 3-8	1	12	81, 82, 84, 85 or 86	20 00

In ordering, state whether Right or Left Hand Cutters are wanted.

Other sizes made to order.

List of Arbors for use with the above Cutters shown on -ge 52.

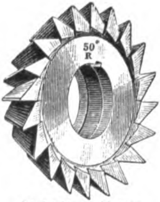
FACE MILLING CUTTERS

With Inserted Teeth and Threaded Holes.

These Cutters are the same in design as shown on opposite page, except that they are provided with Threaded Holes and are used directly upon the Spindle of the Machine.

No. of Mill.	Size.	Machines where used.	Width of Face A.	Width of Face B.	Hole.	Price.
16	7 1-2"	Nos. 1, 1 1-2 & 2 Unv; Nos. 1 & 2 Pl; Vt. Sp. Mil. Atch. for No. 4 Univ. & No. 4 Plain.	2"	1"	2 1-2" 4, L	$18 00
17	7 1-2	No. 3 Univ; No. 3 Pln; Vert. Sp. Mil. Atch. for No. 5 Pln.	"	"	2 3-4" 4, L	18 00
*18	7 1-2	No. 4 Univ; Nos. 4 & 24 Plain; No. 5 Vert. Spin. Mill. Mch.	"	"	3 1-4" 3 1-2 L	18 00
*19	7 1-2	Nos. 5 & 24, Dsg. 1900, Pl.	"	"	4", 3 L	18 00
20	8 1-2	No. 3 Univ; No. 3 Pln; Vert. Sp. Mil. Atch. for No. 5 Pln.	2 3-8	"	2 3-4" 4, L	20 00
*21	8 1-2	No. 4 Univ; Nos. 4 & 24 Plain; No. 5 Vert. Spin. Mill. Mch.	"	"	3 1-4" 3 1-2 L	20 00
22	8 1-2	Nos. 5 & 24, Dsg. 1900, Pl.	"	"	4", 3 L	20 00
23	9 1-2	No. 3 Univ; No. 3 Pln; Vert. Sp. Mil. Atch. for No. 5 Pln.	"	"	2 3-4" 4, L	22 00
*24	9 1-2	No. 4 Univ; Nos. 4 & 24 Plain; No. 5 Vert. Spin. Mill. Mch.	"	"	3 1-4" 3 1-2 L	22 00
*25	9 1-2	Nos. 5 & 24, Dsg. 1900, Pl.	"	"	4", 3 L	22 00

*In ordering give construction number of machine.



Right Hand Cutter.

ANGULAR CUTTERS.

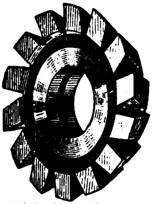
We keep in stock Angular Cutters of 45°, 50°, 60°, 70° and 80° angle, both right and left hand, suitable for cutting the teeth of cutters and mills.

No.	Diameter.	Thickness.	Hole.	Price.
1	2 1-2″	1-2″	7-8″	$2 70
2	2 3-4	1-2	1	3 00
3	3	1-2	1 1-4	3 25

ANGULAR CUTTERS WITH THREADED HOLES.

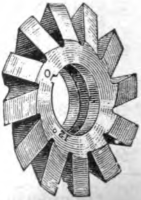
These Cutters have an angle of 60° and are made both Right and Left Hand.

No.	Diameter.	Thickness.	Hole.	Thread.	Price.
1	1 1-4″	7-16″	3-8″	20, L	$2 25
2	1 5-8	9-16	1-2	16, L	2 50



Right Hand Cutter.

ANGULAR CUTTERS AND CUTTERS FOR SPIRAL MILLS.



These cutters can be sharpened by grinding without changing their form, and are made to order.

L. H.

ANGULAR CUTTERS.

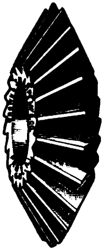
With Side Ground Concave.

These Cutters have the side ground concave, and we carry in stock Cutters of 45°, 50°, 60°, 70° and 80° angle, both Right and Left hand.

In ordering, state whether Right or Left hand is wanted.

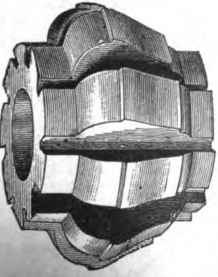
No.	Diameter.	Thickness.	Hole.	Price.
1	2 1-2"	1-2"	7-8"	$2 25
2	2 3-4	1-2	1	2 50
3	3	1-2	1 1-4	2 75

DOUBLE ANGLE CUTTERS.



We carry in stock Cutters of 45°, 60° or 90° included angle.

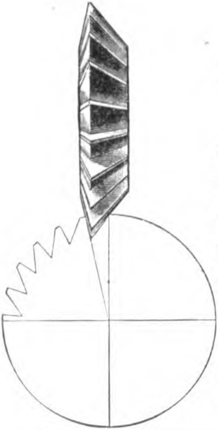
No.	Diameter.	Thickness.	Hole.	Price.
1	2 1-2"	1-2"	7-8"	$2 70
2	2 3-4	1-2	1	3 00
3	3	1-2	1 1-4	3 25



LARGE FORMED MILLING CUTTERS.

Milling Cutters of irregular form are used in gangs limited in size only by the capacity and power of the Milling Machine.

Single Cutters, 7" diameter or 6" long, are not uncommonly made in one piece.



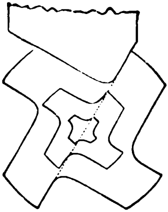
CUTTERS FOR SPIRAL MILLS.

We keep in stock a form of cutter especially adapted to the cutting of spiral mills, either 40°, 48° or 53° angle on one side and 12° on the other, and are right-hand cutters. The cut illustrates a cutter at work, in the position required in cutting the teeth of a spiral cutter.

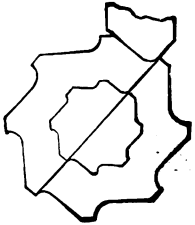
No.	Diameter.	Thickness.	Size of Hole.	Price.
1	2 1-2″	1-2″	7-8″	$2 70
2	2 3-4	1-2	1	3 00
3	3	1-2	1 1-4	3 25

V shaped Cutters of any angle made to order.

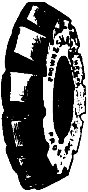
CUTTERS FOR GROOVING TAPS AND REAMERS.



FORM OF TAP.



FORM OF REAMER.



CUTTERS FOR GROOVING TAPS AND REAMERS.

No. of Cutter.	Diameter of Tap.	Number of Teeth in Tap.	Diam. of Cutter.	Hole in Cutter.	Price of Each Cutter.
1	0 to 1-8″	4	1 3-4″	7-8″	$2 00
2	5-32″ " 1-4	4	1 3-4	7-8	2 10
3	9-32 " 3-8	4	1 7-8	7-8	2 20
4	7-16 " 5-8	4	2	7-8	2 40
5	11-16 " 7-8	4	2 1-8	7-8	2 40
6	15-16 " 1 1-4	4	2 1-4	7-8	2 70
7	1 5-16 " 1 5-8	4	2 3-8	7-8	2 70
8	1 11-16 " 2	4	2 5-8	7-8	3 00

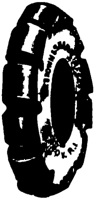
No. 1 Cutter is suitable for grooving taps 1-8″ or less diameter; No. 2 for taps larger than 1-8″ and up to 1-4″ diameter, &c. See cut on preceding page.

These Cutters are also adapted for fluting Reamers, for which purpose it is necessary only to cut one or more grooves of a less depth in order to flute unevenly. See cut on preceding page.

No. of Cutter.	Diameter of Reamer.	Number of Teeth in Reamer.	Diam. of Cutter.	Hole in Cutter.	Price of Each Cutter.
1	1-8″ to 1-4″	6	1 3-4″	7-8″	$2 00
2	9-32 " 3-8	6	1 3-4	7-8	2 10
3	13-32 " 1-2	6	1 7-8	7-8	2 20
4	17-32 " 3-4	6	2	7-8	2 40
	25-32 " 1 1-8	8	2	7-8	2 40
5	1 5-32 " 1 3-8	8	2 1-8	7-8	2 40
	1 13-32 " 1 3-4	10	2 1-8	7-8	2 40
6	1 25-32 " 2	10	2 1-4	7-8	2 70

These Cutters can be sharpened by grinding without changing their form.

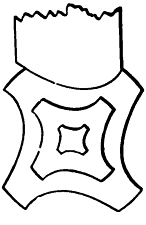
In ordering, give number of Cutter, or diameter and number of teeth of Tap or Reamer as by above lists.



CUTTERS FOR GROOVING TAPS.

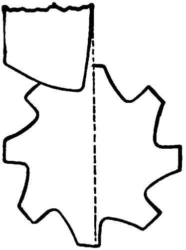
Number of Cutter.	Diameter of Tap.	Diameter of Cutter.	Hole in Cutter.	Price of Each Cutter.
1	0 to 1-8″	1 3-4″	7-8″	$2 00
2	5-32 " 1 4	1 3-4	7-8	2 10
3	9 32 " 3-8	1 7-8	7 8	2 20
4	7-16 " 5-8	2	7-8	2 40
5	11 16 " 7-8	2 1-8	7-8	2 40
6	15-16 " 1 1-4	2 1-4	7-8	2 70
7	1 5-16 " 1 5-8	2 3-8	7-8	2 70
8	1 11-16 " 2	2 5-8	7-8	3 00

We have added to our stock a style of Cutter adapted to grooving taps only. These cutters do not make as deep a groove in proportion to the width as the Tap and Reamer Cutters. They are not suitable for fluting reamers. See cut below. These cutters can be sharpened by grinding without changing their form. In ordering, give number of Cutter or diameter of Tap, as by above list.



FORM OF TAP

CUTTERS
FOR FLUTING REAMERS.



The cut shows a form of Cutter that makes a tooth that allows the chips to be removed more readily and has greater strength than the form made by the Cutters for Grooving Taps and Reamers.

In ordering, give number of Cutter or diameter of Reamer as by the following list.

No. of Cutter.	Diameter of Reamer.	Number of Teeth.	Hole in Cutter.	Price.
1	1-8″ to 3-16″	6	7-8″	$2 00
2	1-4 " 5-16	6	7-8	2 10
3	3-8 " 7-16	6	7-8	2 20
4	1-2 " 11-16	6 to 8	7-8	2 40
5	3-4 " 1	8	7-8	2 40
6	1 1-16 " 1 1-2	10	7-8	2 70
7	1 9-16 " 2 1-8	12	7-8	2 70
8	2 1-4 " 3	14	7-8	3 00

CUTTERS WITH SPECIAL HOLES.

These Cutters are among those furnished with the sets of tools sent with milling machines and are not otherwise listed.

Name of Cutter.	Diameter.	Width of Face.	Hole.	Price.
Face Mill with Hub	4″	1″	No. 10 Taper	$10 00
Face Mill	4	1	1″, 10, L.	7 00
Face Mill	5	1 1-4	1, 10, L.	9 00
Milling Cutter . .	1 1-4	3-16	3-8, 20, L.	1 50
Milling Cutter . .	1 11-16	3-16	1-2, 16, L.	1 75
Profiling Cutter .	2 1-2	2 1-2	No. 10 Taper	5 75
Angular Cutter, 60°, with Hub, L. H.	3 3-4	1 1-4	No. 10 Taper	10 00

For List of Arbors, see page 51.

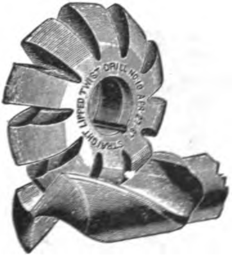
CUTTERS FOR MAKING TWIST DRILLS.

Number of Cutter.	Diameter of Drill.	Diam. of Circle made by Cutter.	Diameter of Cutter.	Hole in Cutter.	Price of Each Cutter.
1	1-16″	.06	1 3-4″	7-8″	$1 50
2	1-8	.08	1 3-4	7-8	1 70
3	3-16	.11	1 3-4	7-8	1 90
4	1-4	.15	1 3-4	7-8	2 10
5	5-16	.19	2	7-8	2 30
6	3-8	.23	2	7-8	2 40
7	7-16	.27	2	7-8	2 60
8	1 2	.31	2	7-8	2 80
9	9-16	.35	2 1-8	7-8	3 00
10	5-8	.39	2 1-8	7-8	3 20
11	11 16	.44	2 1-8	7-8	3 40
12	3-4	.50	2 1-4	7-8	3 60
13	13-16	.56	2 1-4	7-8	3 80
14	7-8	.62	2 1-2	7-8	4 00
15	15-16	.70	2 1-2	7-8	4 20
16	1	.77	2 3-4	7-8	4 50
17	1 1-8	.85	2 3-4	7-8	5 00

These Cutters can be sharpened by grinding without changing their form.

In ordering, give number of Cutter or diameter of Drill as by above list.

CUTTERS FOR MAKING STRAIGHT LIPPED TWIST DRILLS.

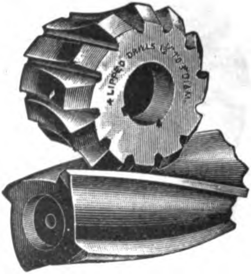


No. Cutter.	Diameter of Drill.	Diameter of Cutter.	Hole in Cutter.	Price of Cutter
1	1-16"	1 3-4"	[illegible]	$1 [illegible]
2	1-8	1 3-4	[illegible]	1 70
3	3-16	1 3-4	[illegible]	1 [illegible]
4	1-4	1 3-4	[illegible]	2 [illegible]
5	5-16	2	[illegible]	2 [illegible]
6	3-8	2	[illegible]	2 [illegible]
7	7-16	2	[illegible]	2 [illegible]
8	1-2	2	[illegible]	2 [illegible]
9	9-16	2 1-4	[illegible]	[illegible]
10	5-8	2 1-4	[illegible]	[illegible]
11	11-16	2 1-4	[illegible]	[illegible]
12	3-4	2 1-4	[illegible]	[illegible]
13	13-16	2 1-2	[illegible]	[illegible]
14	7-8	2 1-2	[illegible]	[illegible]
15	15-16	2 1-2	[illegible]	[illegible]
16	1	2 3-4	[illegible]	[illegible]
17	1 1-8	2 3-4	[illegible]	[illegible]
18	1 1-4	3	[illegible]	[illegible]
19	1 1-2	[illegible]	[illegible]	[illegible]
20	1 3-4	[illegible]	[illegible]	[illegible]
21	2	[illegible]	[illegible]	[illegible]

These Cutters can [illegible] changing their form.

In ordering, give number [illegible] as by above list.

CUTTERS FOR MAKING FOUR-LIPPED TWIST DRILLS.



The cut shows a form of cutter, which we carry in stock, especially adapted to cutting Four-Lipped Twist Drills that are used in screw and chucking machines for roughing out holes previous to reaming. These drills are made, when possible, as shell drills to be used on an arbor, and should have a spiral or "twist" of fifteen degrees.

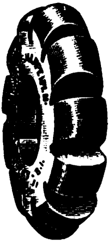
In ordering give number of cutter or size of drill as by the following list.

These cutters can be sharpened by grinding without changing their form.

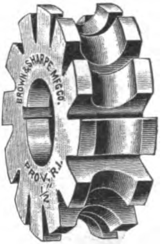
No. Cutter.	Diameter of Drill.	Diameter of Cutter.	Hole in Cutter.	Price of Cutter.
1	to 1 1-2"	2 3-4"	1"	$6 00
2	1 1-2 to 3	3	1	7 00

CONVEX AND CONCAVE CUTTERS

For Milling Half Circles.



Convex.

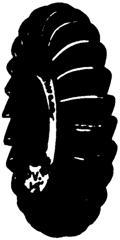


Concave.

These Cutters can be sharpened by grinding without changing their outline.

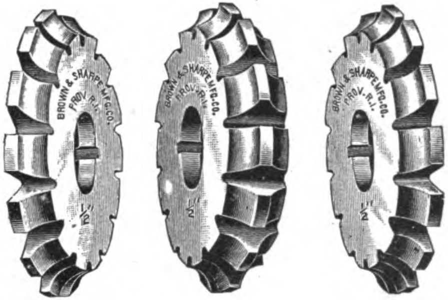
No.	Diameter of Circle.	Diameter of Cutter.	Size of Hole.	Convex Cutter. Price.	Concave Cutter. Price.
10	1-8″	2″	7-8″	$2 00	$2 40
11	3-16	2	7-8	2 25	2 70
12	1-4	2	7-8	2 50	3 00
13	5-16	2 1-4	7-8	2 80	3 35
14	3-8	2 1-4	7-8	3 10	3 70
15	7-16	2 1-4	7-8	3 35	4 00
16	1-2	2 1-4	7-8	3 60	4 30
17	5-8	2 3-4	1	4 00	4 80
18	3-4	3	1	4 40	5 25
19	7-8	3 1-4	1	4 80	5 75
20	1	3 1-4	1	5 25	6 30
21	1 1-8	3 1 2	1	5 75	6 90
22	1 1-4	3 1 2	1	6 25	7 50
23	1 3-8	3 3-4	1	7 00	8 40
24	1 1-2	3 3-4	1	7 75	9 30

CONVEX CUTTERS AND INTERLOCKING CONCAVE CUTTERS.



No.	Diameter of Circle.	Diameter o Cutter.	Size of Hole.	Convex Cutter Price.	Interlocking Concave Cutter Price.
30	3-8"	2 1-4"	7-8"	$3 10	$5 25
31	1-2	2 1-4	7-8	3 60	6 10
32	5-8	2 3-4	1	4 00	6 80
33	3-4	3	1	4 40	7 50
34	7-8	3 1-4	1	4 80	8 15
35	1	3 1-4	1	5 25	8 90
36	1 1-8	3 1-2	1	5 75	9 75
37	1 1-4	3 1-2	1	6 25	10 60
38	1 3-8	3 3-4	1	7 00	11 90
39	1 1-2	3 3-4	1	7 75	13 15

CORNER-ROUNDING CUTTERS.



Left Hand. Double. Right Hand.

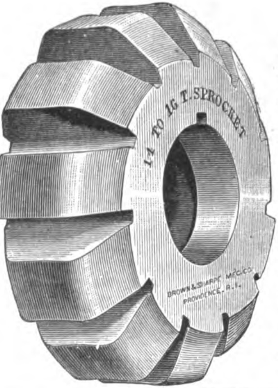
These Cutters have side as well as radial clearance and can be ground without changing their outline.

In ordering single Cutters, state whether Right or Left hand is wanted.

No.	Radius of Circle.	Diameter.	Hole.	Price Single Cutter.	Price Double Cutter.
10	1-16"	2"	7-8"	$2 00	$2 40
11	3-32	2	7-8	2 25	2 70
12	1-8	2	7-8	2 50	3 00
13	5-32	2 1-4	7-8	2 70	3 35
14	3-16	2 1-4	7-8	2 90	3 70
15	7-32	2 1-4	7-8	3 10	4 00
16	1-4	2 1-4	7-8	3 30	4 30
17	5-16	2 3-4	1	3 50	4 80
18	3-8	3	1	3 70	5 25
19	7-16	3 1-4	1	3 90	5 75
20	1-2	3 1-4	1	4 20	6 30
21	9-16	3 1-2	1	4 50	6 90
22	5-8	3 1-2	1	5 00	7 50
23	11-16	3 3-4	1	5 75	8 40
24	3-4	[illegible]	1	6 50	9 30

SPROCKET WHEEL CUTTERS

For Block Centre Chains.



We carry in stock a form of Sprocket Wheel Cutter for the ordinary 1″ pitch chain.

The Cutters for the smaller sized wheels are for cutting a curved form of tooth, to prevent the chain from mounting the sprocket, while the cutters for the larger sized wheels make a straight sided tooth.

Cutters of special forms, or to cut two teeth at one time, are made to order.

No. of Teeth of Sprocket	Diameter of Cutter.	Hole in Cutter.	Price Single Cutter.
6	2 3-4″	1″	$6 00
7	2 3-4	1	6 00
8	2 3-4	1	6 00
9	2 3-4	1	6 00
10 and 11	2 3-4	1	6 00
12 and 13	2 3-4	1	6 00
14 to 16	2 3-4	1	6 00
17 to 20	2 3-4	1	6 00
21 and over.	2 3-4	1	6 00

Double Cutters, Price, $13 00 Per Pair.

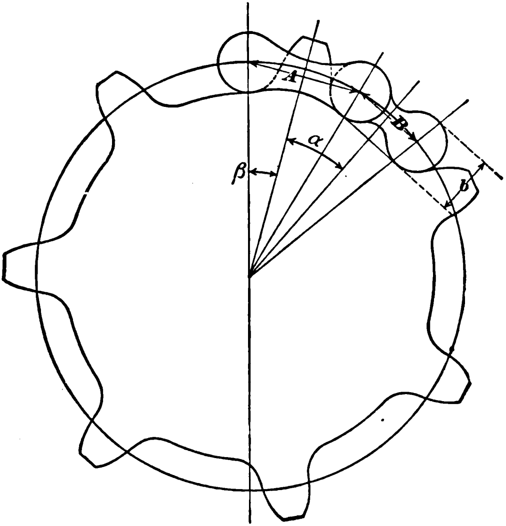
CUTTERS FOR SAWING BICYCLE CHAIN LINKS.

These Cutters are especially adapted to run in gangs, for sawing bicycle chain links. Like metal slitting saws they are ground on the sides for clearance. They are .092″ thick and made in two sizes, as follows: 3″ diameter, 1″ hole; and 3 1-4″ diameter, 1 1-4″ hole.

Price, $1 00 each.

FORMULA

For Calculating Diameters of Sprocket Wheels for Block Centre Chains.



N = No. of Teeth.

b = Diameter of Round Part of Chain Block.

B = Centre to Centre of holes in Chain Block.

A = Centre to Centre of holes in side links.

$$\alpha = \frac{180^\circ}{N}$$

$$\text{Tan. } \beta = \frac{\text{Sin. } \alpha}{\frac{B}{A} + \text{Cos. } \alpha}$$

$$\text{Pitch Diam.} = \frac{A}{\text{Sin. } \beta}$$

Outside Diam. = Pitch Diam. + b

Bottom Diam. = Pitch Diam. − b

In calculating the diameter of Sprocket Wheels the Bottom Diameter is the most important.

SPROCKET WHEEL CUTTERS

For Roller Chains and Block Centre Chains.

We furnish at short notice Sprocket Wheel Cutters for Roller Chains and Block Centre Chains.

Cutters for Roller Chains.

Circular Pitch.	Diameter of Rolls.	Diameter of Cutter.	Hole in Cutter.	Price.
3-4"	.47"	3"	1"	$6 50
15-16	.5625"	3 3.8	1	7 00
1	.5625" or .625"	3 3-8	1	7 00
1 1-4	.625" or .750"	3 3-4	1 1-4	7 50
1 1-2	.75" or .875"	4	1 1-4	8 00

In ordering, specify the number of teeth in the sprocket, and the diameter of the roller.

Cutters for Block Centre Chains.

Circular Pitch.	Thickness of Block.	Diameter of Cutter.	Centre to Centre of Block.	Hole in Cutter.	Price.
1 5-16"	.4375"	3 1-2"	.5313"	1 1-4"	$7 50
1 1-2	17-32	3 3-4	.5625	1 1-4	8 00

Seven Cutters are made for each pitch, for Nos. of teeth as follows: 8, 9, 10 and 11, 12 and 13, 14 to 16, 17 to 20, 21 and over.

For List of Sprocket Wheels for the ordinary 1" Pitch Chain, see page 258.

FORMULA

For Calculating Diameters of Sprocket Wheels for Roller Chains.

N = Number of Teeth in Sprocket.

P = Pitch of Chain.

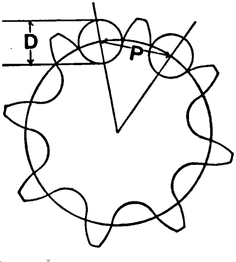
D = Diameter of Roller.

$$\alpha = \frac{180^\circ}{N}$$

$$\text{Pitch Diameter} = \frac{P}{\text{Sin. } \alpha}$$

Outside Diameter = Pitch + D.

Bottom Diameter = Pitch − D.



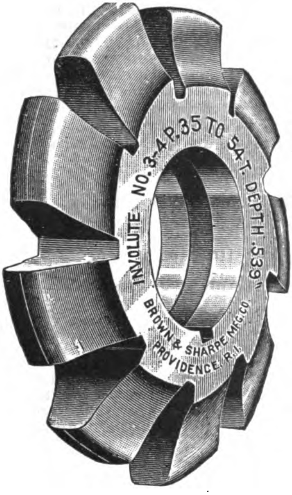
PATENT CUTTERS

FOR THE

TEETH OF GEAR WHEELS,

WHICH CAN BE

Sharpened by Grinding Without Changing Their Form.



The Patent Cutters for the teeth of Gear Wheels, from their peculiar construction, can be sharpened when dull by grinding the faces of the teeth. This operation can be repeated without altering the form of the tooth which the Cutter makes, thereby rendering them many times more valuable than Cutters of ordinary form.

Cutters marked * are not kept in stock, but are made to order at short notice.

Orders should be given by annexed tables, stating the *No. of Cutter* and the *Diametral Pitch* required. By *Diametral Pitch* is meant the number of teeth to the inch in diameter on pitch circle of any wheel. In ordering Cutters for worm wheels, give the *number of teeth in wheel, the diameter of worm and number of threads to the inch.*

Centre Line on Gear Cutters. We would call attention to the centre line on our Gear Cutters, which may be convenient in setting cutters o[illegible] the work spindle.

DIRECTIONS FOR USING THE CUTTERS.

The Cutters should be kept perfectly sharp by grinding the face of the teeth on the side of a solid emery or vulcanite wheel, which has its edge beveled on one side so as to reach to the bottom of the teeth. This wheel should be put on an arbor with a shoulder and nut, so that the flat side will run true and at a velocity of from 2000 to 3000 revolutions per minute. If used in a common hand lathe the top of the rest should be made square or vertical to the face of the wheel, or what is better, use a small platform in the place of the rest. Then, by laying the cutter on the rest or platform, the face of the teeth can be ground square, which is very important. The cutters should not be crowded too hard, especially when cutting through at the end of the tooth. *The depth of the space made by these cutters affords ample clearance, as it exceeds the working depth of the tooth by an amount equal to one-tenth of the thickness of the tooth on the pitch line.*

PATENT INVOLUTE CUTTERS

For Teeth of Gear Wheels.

Eight Cutters are made for each pitch, as follows:

No. 1	will cut	wheels	from	135	teeth	to a	rack.	
" 2	"	"	"	55	"	"	134	teeth.
" 3	"	"	"	35	"	"	54	"
" 4	"	"	"	26	"	"	34	"
" 5	"	"	"	21	"	"	25	"
" 6	"	"	"	17	"	"	20	"
" 7	"	"	"	14	"	"	16	"
" 8	"	"	"	12	"	"	13	"

We are prepared to furnish to order Gear Cutters from 2 to 8 pitch inclusive of half numbers, for the accommodation of those who require a finer division of the number of teeth to be cut with each cutter than can be cut with the regular number. The Nos. 1 to 8, as listed above, are the regular cutters as furnished heretofore.

The half numbers are as follows:

No. of Cutter.	Range.	No. of Cutter.	Range.
1 1-2	80 to 134 teeth.	5 1-2	19 to 20 teeth.
2 1-2	42 " 54 "	6 1-2	15 " 16 "
3 1-2	30 " 34 "	7 1-2	13
4 1-2	23 " 25 "		

In ordering, give the *No. of Cutter* and *Diametral Pitch* required. Cutters in stock can be ordered by telegraph. Form of Telegram:—"*Send one Cutter, No. five, eight pitch.*" When ordering Cutters for Bevel Gears, note instructions given on pages 280 and 281.

For Prices, see pages 263 to 277.

KEEP CUTTERS SHARP.

PATENT INVOLUTE CUTTERS

FOR TEETH OF GEAR WHEELS.

All Gears of same Pitch cut with these Cutters are interchangeable.

Diametral Pitch.	Diameter of Cutter.	Hole in Cutter.	Price of each Cutter.
*1 1-4	7 1-4"	1 1-2"	$32 00
*1 1-2	6 1-2	1 1-2	24 00
*1 3-4	5 3-4	1 1-2	18 50
*2	5	1 1-4	12 50
*2 1-4	4 1-2	1 1-4	11 25
*2 1-2	4 1-4	1 1-4	10 00
*2 3-4	4	1 1-4	9 00
3	3 13-16	1 1-4	7 00
*3 1-4	3 13-16	1 1-4	6 50
*3 1-2	3 9-16	1 1-4	6 25
*3 3-4	3 9-16	1 1-4	6 00
4	3 3-8	1 1-4	5 50
*4 1-2	3 1-4	1 1-4	5 00
5	3 1-16	1 1-4	4 50
*5 1-2	3 1-16	1 1-4	4 20
6	2 3-4	1 1-16	3 90
7	2 9-16	1 1-16	3 60
8	2 1-2	1 1-16	3 40
9	2 3-8	1 1-16	3 20
10	2 1-8	7-8	3 00
11	2 1-16	7-8	2 75
12	2	7-8	2 65
*13	2	7-8	2 60
14	2	7-8	2 55
*15	2	7-8	2 50
16	1 15-16	7-8	2 45
18	1 15-16	7-8	2 35
20	1 7-8	7-8	2 30
22	1 13-16	7-8	2 20
24	1 3-4	7-8	2 10
26	1 3-4	7-8	1 95
28	1 3-4	7-8	1 80
30	1 3-4	7-8	1 80
32	1 3-4	7-8	1 80
36	1 3-4	7-8	1 80
*38	1 3-4	7-8	1 80
40	1 3-4	7-8	1 80
*44	1 3-4	7-8	1 80
48	1 3-4	7-8	1 80
*50	1 3-4	7-8	1 80
*56	1 3-4	7-8	1 80
*60	1 3-4	7-8	1 80
*64	1 3-4	7-8	1 80
*70	1 3-4	7-8	1 80
*80	1 3-4	7-8	1 80
*120	1 3-4	7-8	1 80

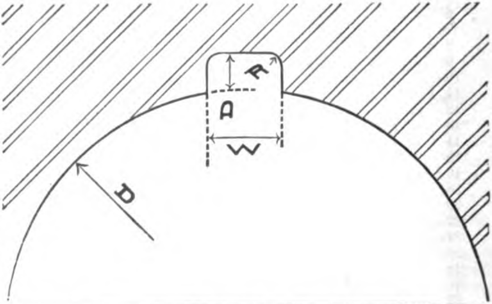
Cutters marked * are not kept in stock, but are made to order.
Eight Cutters made for each pitch; see page 262.

KEEP CUTTERS SHARP.

TAPER REAMERS.

No. of Taper.	Length of Flutes.	Price.	No. of Taper.	Length of Flutes.	Price.
1	2 7-8"	$1 75	9	6 1-8	$4 00
2	3 1-8	2 00	10	6 7-8	5 00
3	3 3-8	2 25	11	7 5-8	6 00
4	3 11-16	2 50	12	8 1-4	8 00
5	4	3 00	13	8 3-4	10 00
6	4 3-8	3 25	14	9 1-4	12 00
7	4 7-8	3 50	16	10	16 00
8	5 1-2	3 75	18	10 3-4	22 00

STANDARD KEYWAYS FOR CUTTERS.



Diameter (D) of Hole.	Width (W) of Keyway.	Depth (D) of Keyway.	Radius (R).
3-8" to 9-16"	3-32"	3-64"	.020"
5-8 to 7-8	1-8	1-16	.030
15-16 to 1 1-8	5-32	5-64	.035
1 3-16 to 1 3-8	3-16	3-32	.040
1 7-16 to 1 3-4*	1-4	1-8	.050
1 13-16 to 2	5-16	5-32	.060
2 1-16 to 2 1-2	3-8	3-16	.060
2 9-16 to 3	7-16	3-16	.060

*1 1-2" For Cutters for Brown & Sharpe Automatic Gear Cutting Machine, use 5-16" key.
*1 3-4" For Cutters for Brown & Sharpe Automatic Gear Cutting Machine, use 3-8" key.

PATENT

INVOLUTE CUTTERS

FOR TEETH OF GEAR WHEELS.

FOR USE ON

No. 3 Automatic Gear Cutting Machines.

Diametral Pitch.	Diam. of Cutter.	Hole in Cutter.	Price.
*4	3 1-2″	1″	$5 50
*4 1-2	3 3-8	1	5 00
5	3 1-4	1	4 50
*5 1-2	3 1-8	1	4 20
6	3	1	3 90
7	2 7-8	1	3 60
8	2 7-8	1	3 40
9	2 3-4	1	3 20
10	2 3-4	1	3 00
11	2 5-8	1	2 75
12	2 5-8	1	2 65
*13	2 5-8	1	2 60
14	2 1-2	1	2 55
*15	2 1-2	1	2 50
16	2 1-2	1	2 45
18	2 3-8	1	2 35
20	2 3-8	1	2 30
22	2 1-4	1	2 20
24	2 1-4	1	2 10
*26	2 1-4	1	2 00
*28	2 1-4	1	2 00
*30	2 1-4	1	2 00
*32	2 1-4	1	2 00
*36	2 1-4	1	2 00
*40	2 1-4	1	2 00
*48	2 1-4	1	2 00

Cutters marked * are not kept in stock but are made to order.

Eight Cutters made for each pitch. See page 262.

KEEP CUTTERS SHARP.

PATENT INVOLUTE CUTTERS

For Teeth of Gear Wheels.

FOR USE ON No. 4 AUTOMATIC GEAR CUTTING MACHINES.

Diametral Pitch.	Diam. of Cutter.	Hole in Cutter.	Price.
*3	4 1-4"	1 1-4"	$7 50
*3 1-2	4	1 1-4	6 75
4	3 3-4	1 1-4	6 00
*4 1-2	3 3-4	1 1-4	5 50
5	3 5-8	1 1-4	5 25
*5 1-2	3 5-8	1 1-4	5 00
6	3 1-2	1 1-4	4 75
7	3 3-8	1 1-4	4 50
8	3 1-4	1 1-4	4 25
9	3 1-8	1 1-4	4 00
10	3	1 1-4	3 75
11	2 7-8	1 1-4	3 50
12	2 7-8	1 1-4	3 25
*14	2 7-8	1 1-4	3 00
*16	2 7-8	1 1-4	3 00
*18	2 7-8	1 1-4	3 00
*20	2 3-4	1 1-4	3 00

FOR USE ON No. 5 AUTOMATIC GEAR CUTTING MACHINES.

Diametral Pitch.	Diam. of Cutter.	Hole in Cutter.	Price.
*2	5 3-4"	1 1-2"	$13 50
*2 1-4	5 1-2	1 1-2	12 25
*2 1-2	5	1 1-2	10 50
*2 3-4	4 3-4	1 1-2	9 50
3	4 3-4	1 1-2	8 00
*3 1-4	4 1-2	1 1-2	7 75
*3 1-2	4 3-8	1 1-2	7 25
*3 3-4	4 1-4	1 1-2	6 75
4	4 1-4	1 1-2	6 25
*4 1-2	4 1-8	1 1-2	5 75
5	4	1 1-2	5 25
*5 1-2	3 7-8	1 1-2	5 00
6	3 3-4	1 1-2	4 75
7	3 5-8	1 1-2	4 50
8	3 1-2	1 1-2	4 25
*9	3 1-2	1 1-2	4 00
*10	3 1-2	1 1-2	3 75

Cutters marked * are not kept in stock, but are made to order.
Eight Cutters made for each pitch; see page 262,

KEEP CUTTERS SHARP.

PATENT INVOLUTE CUTTERS

For Teeth of Gear Wheels.

FOR USE ON

No. 6 AUTOMATIC GEAR CUTTING MACHINES.

Diametral Pitch	Diam. of Cutter.	Hole in Cutter.	Price.
*1 3-4	6 1-2"	1 3-4"	$18 50
2	6 1-4	1 3-4	14 00
*2 1-4	6	1 3-4	12 75
2 1-2	5 3-4	1 3-4	11 00
*2 3-4	5 1-2	1 3-4	10 00
3	5 1-4	1 3-4	8 50
*3 1-4	5 1-8	1 3-4	8 25
*3 1-2	4 7-8	1 3-4	7 75
*3 3-4	4 3-4	1 3-4	7 25
4	4 5-8	1 3-4	6 75
*4 1-2	4 1-2	1 3-4	6 25
5	4 3-8	1 3-4	5 75
*5 1-2	4 3-8	1 3-4	5 75
6	4 1-4	1 3-4	5 50
*7	4 1-8	1 3-4	5 25
*8	4	1 3-4	5 00

Cutters marked * are not kept in stock, but are made to order.

CUTTERS FOR MITRE AND BEVEL GEARS.

FOR USE ON

No. 13 AUTOMATIC GEAR CUTTING MACHINES.

Diametral Pitch.	Diam. of Cutter.	Hole in Cutter.	Price.
4	3 3-4"	1 1-4"	$5 50
5	3 5-8	1 1-4	4 50
6	3 1-2	1 1-4	3 90
7	3 1-2	1 1-4	3 60
8	3 1-4	1 1-4	3 40
10	3 1-4	7-8	3 00
12	3	7-8	2 65
14	3	7-8	2 55
16	2 3-4	7-8	2 45
20	2 1-2	7-8	2 30
24	2 1-4	7-8	2 10

Eight Cutters made for each pitch; see page 262.

KEEP CUTTERS SHARP.

PATENT
INVOLUTE GEAR CUTTERS.
CIRCULAR PITCH.

We furnish, at short notice, Cutters for cutting the teeth of Gear Wheels according to Circular Pitch.

Circular Pitch.	Diameter of Cutter.	Hole.	Price.
1-8"	1 3-4"	7-8"	$2 60
1-8	2 7-8	1 1-4	2 75
3-16	2	7-8	2 95
3-16	2 7-8	1 1-4	3 00
1-4	2	7-8	3 15
1-4	2 7-8	1 1-4	3 25
1-4	4 1-4	1 1-2 or 2	4 75
5-16	2 1-8	7-8	3 50
5-16	2 7-8	1 1-4	3 75
5-16	4 1-4	1 1-2 or 2	5 00
3-8	2 1-2	1 1-16	3 90
3-8	2 7-8	1 1-4	4 25
3-8	4 1-4	1 1-2 or 2	5 00
7-16	2 5-8	1 1-16	4 10
7-16	3 1-2	1 1-4	4 50
7-16	4 1-4	1 1-2 or 2	5 25
1-2	2 3-4	1 1-16	4 40
1-2	3 1-2	1 1-4	4 75
1-2	4 1-4	1 1-2 or 2	5 50
9-16	3 1-8	1 1-4	4 70
9-16	3 1-2	1 1-4	5 00
9-16	4 1-4	1 1-2 or 2	6 00
5-8	3 1-8	1 1-4	5 00
5-8	3 1-2	1 1-4	5 25
5-8	5 1-4	1 1-2 or 2	6 50
11-16	3 1-4	1 1-4	5 50
11-16	3 1-2	1 1-4	5 75
11-16	5 1-4	1 1-2 or 2	7 00
3-4	3 3-8	1 1-4	6 00
3-4	4	1 1-4	6 25
3-4	5 1-4	1 1-2 or 2	8 00
13-16	3 5-8	1 1-4	6 50
13-16	4	1 1-4	6 50
13-16	5 1-4	1 1-2 or 2	8 00
7-8	3 5-8	1 1-4	6 75
7-8	4	1 1-4	6 75
7-8	5 1-4	1 1-2 or 2	8 25

KEEP CUTTERS SHARP.

PATENT INVOLUTE GEAR CUTTERS,
Circular Pitch—Continued.

Circular Pitch.	Diameter of Cutter.	Hole.	Price.
15-16″	3 7-8″	1 1-4″	$7 00
15-16	4	1 1-4	7 25
15-16	5 1-4	1 1-2 or 2	8 50
1	3 7-8	1 1-4	7 50
1	4 3-4	1 1 4	8 00
1	5 1-4	1 1-2 or 2	8 50
1 1-8	4	1 1-4	9 50
1 1-8	4 3-4	1 1-4	9 50
1 1-8	5 1-4	1 1-2 or 2	10 00
1 1-4	4 1-4	1 1-4	10 50
1 1-4	4 3-4	1 1-4	10 50
1 1-4	6 1-4	1 1-2 or 2	12 00
1 3-8	4 1-2	1 1-4	11 75
1 3-8	4 3-4	1 1-4	11 75
1 3-8	6 1-4	1 1-2 or 2	12 75
1 1-2	5	1 1-4	12 50
1 1-2	6 1-4	1 1-2 or 2	14 50
1 3-4	5 3-4	1 1-2	18 50
1 3-4	6 1-4	1 1-2 or 2	18 50
2	6 1-2	1 1-2	24 50
2	7 1-4	1 1-2 or 2	26 50
2 1-4	7	1 1-2	28 50
2 1-4	7 1-4	1 1-2 or 2	29 00
2 1-2	7 1-4	1 1-2	32 00
2 1-2	7 1-4	1 1-2 or 2	32 00
2 3-4	8	1 1-2 or 2	35 00
3	8	1 1-2 or 2	38 00

KEEP CUTTERS SHARP.

FORMULAS FOR DETERMINING THE DIMENSIONS OF GEARS BY METRIC PITCH.

Module is the pitch diameter in mm. divided by the number of teeth in the gear.

Pitch diameter in mm. is the Module multiplied by the number of teeth in the gear.

M = Module.

D' = The pitch diameter of gear.

D = The whole diameter of gear.

N = The number of teeth in gear.

D" = The working depth of teeth.

t = Thickness of teeth on pitch line.

f = Amount added to depth for clearance.

Then

$$M = \frac{D'}{N} \text{ or } \frac{D}{N+2}$$

$$D' = N\,M.$$

$$D = (N+2)\,M.$$

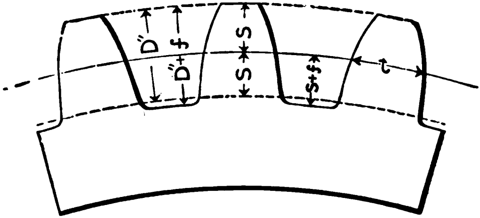
$$N = \frac{D'}{M} \text{ or } \frac{D}{M} - 2.$$

$$D'' = 2\,M.$$

$$t = M\ 1.5708.$$

$$f = \frac{M\ 1.5708}{10}$$

The Module is equal to the part marked "S" in cut, measured in mm. and parts of mm.



PITCHES COMMONLY USED.

Module in Millimetres.

Module.	Corresponding English Diametral Pitch.	Module.	Corresponding English Diametral Pitch.
1 mm.	25.400	5 mm.	5.080
1.25	20.320	5.5	4.618
1.5	16.933	6	4.233
1.75	14.514	7	3.628
2	12.700	8	3.175
2.25	11.288	9	2.822
2.5	10.160	10	2.540
2 75	9.236	11	2.309
3	8.466	12	2.117
3.5	7.257	14	1.814
4	6 350	16	1.587
4.5	5.644		

PATENT
METRIC INVOLUTE CUTTERS
For Teeth of Gear Wheels.

We are prepared to furnish, at short notice, cutters for cutting the teeth of Gear Wheels according to the Metric system.

Module is the Pitch Diameter in m/m divided by the number of teeth in the gear.

Pitch Diameter in m/m is the Module multiplied by the number of teeth in the gear.

M = Module. D′ = Pitch Diameter in m/m.
N = No. of Teeth in Gear. D′ = M × N.

For example: M = 3.50 m/m; N = 100; D′ = 3.50 × 100 = 350 m/m. For further explanation see page 270.

Module in First Column.

Module.	Diameter.	Hole.	Price.
1-2 m/m	1 3-4″	7-8″ or 22 m/m	$1 80
3-4	1 3-4	"	1 80
1	1 3-4	"	2 10
1 1-4	1 7-8	"	2 30
1 1-2	1 15-16	"	2 45
1 3-4	2	"	2 55
2	2	"	2 65
2 1-4	2 1-16	"	2 75
2 1-2	2 1-8	"	3 00
3	2 1-2	1 1-16″ or 27 m/m	3 40
3 1-4	2 9-16	"	3 50
3 1-2	2 9-16	"	3 60
3 3-4	2 3-4	"	3 75
4	2 3-4	"	3 90
4 1-4	3	1 1-4″ or 32 m/m	4 05
4 1-2	3	"	4 20
4 3-4	3 1-16	"	4 35
5	3 1-16	"	4 50
5 1-4	3 1-4	"	4 75
5 1-2	3 1-4	"	5 00
5 3-4	3 3-8	"	5 25
6	3 3-8	"	5 50
7	3 9-16	"	6 25
8	3 13-16	"	7 00
9	4	"	9 00
10	4 1-4	"	10 00
11	4 1-2	"	11 25
12	5	"	12 50

Eight Cutters made for each Pitch; see page 262.

KEEP CUTTERS SHARP.

PATENT
METRIC INVOLUTE CUTTERS
FOR TEETH OF GEAR WHEELS.
FOR USE ON
No. 3 Automatic Gear Cutting Machines.

Module in First Column.

Module.	Diameter.	Hole.	Price.
3-4 m/m	2 1-4"	1"	$2 00
1	2 1-4	"	2 10
1 1-4	2 3-8	"	2 30
1 1-2	2 1-2	"	2 45
1 3-4	2 1-2	"	2 55
2	2 5-8	"	2 65
2 1-4	2 5-8	"	2 75
2 1-2	2 3-4	"	3 00
3	2 7-8	"	3 40
3 1-2	2 7-8	"	3 60
4	3	"	3 90
4 1-2	3 1-8	"	4 20
5	3 1-4	"	4 50
5 1-2	3 3-8	"	5 00
6	3 1-2	"	5 50

FOR USE ON
No. 4 Automatic Gear Cutting Machines.

Module in First Column.

Module.	Diameter.	Hole.	Price.
1 1-4 m/m	2 3-4"	1 1-4"	$3 00
1 1-2	2 7-8	"	3 00
1 3-4	2 7-8	"	3 00
2	2 7-8	"	3 25
2 1-4	2 7-8	"	3 50
2 1-2	3	"	3 75
3	3 1-4	"	4 25
3 1-2	3 3-8	"	4 50
4	3 1-2	"	4 75
4 1-2	3 5-8	"	5 00
5	3 5-8	"	5 25
5 1-2	3 3-4	"	5 50
6	3 3-4	"	6 00
7	4	"	6 75
8	4 1-4	"	7 50

Eight Cutters made for each pitch; see page 262.

KEEP CUTTERS SHARP.

PATENT
METRIC INVOLUTE CUTTERS
FOR TEETH OF GEAR WHEELS.
FOR USE ON
No. 5 Automatic Gear Cutting Machines.
Module in First Column.

Module.	Diameter.	Hole.	Price.
2 1-2 m/m	3 1-2"	1 1-2"	$3 75
3	3 1-2	"	4 25
3 1-2	3 5-8	"	4 50
4	3 3-4	"	4 75
4 1-2	3 7-8	"	5 00
5	4	"	5 25
5 1-2	4 1-8	"	5 75
6	4 1-4	"	6 25
7	4 3-8	"	7 25
8	4 3-4	"	8 00
9	4 3-4	"	9 50
10	5	"	10 50
11	5 1-2	"	12 25
12	5 3-4	"	13 50

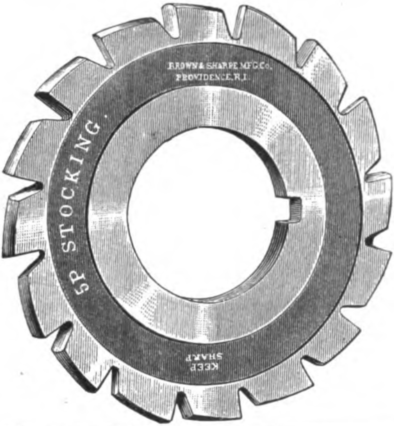
FOR USE ON
No. 6 Automatic Gear Cutting Machines.
Module in First Column.

Module.	Diameter.	Hole.	Price.
3 m/m	4"	1 3-4"	$5 00
3 1-2	4 1-8	"	5 25
4	4 1-4	"	5 50
4 1-2	4 3-8	"	5 75
5	4 3-8	"	5 75
5 1-2	4 1-2	"	6 25
6	4 5-8	"	6 75
7	4 7-8	"	7 75
8	5 1-4	"	8 50
9	5 1-2	"	10 00
10	5 3-4	"	11 00
11	6	"	12 75
12	6 1-4	"	14 00

Eight Cutters made for each pitch. See page 262.

KEEP CUTTERS SHARP.

IMPROVED STOCKING CUTTERS FOR INVOLUTE GEARS.



Diametral Pitch.	Diameter of Cutter.	Size of Hole in Cutter.	Price of Each Cutter.
*1 1-4	7 1-4″	1 1-2″	$19 20
*1 1-2	6 1-2	1 1-2	14 40
*1 3-4	5 3-4	1 1-2	11 10
2	5	1 1-4	7 50
*2 1-4	4 1-2	1 1-4	6 75
2 1-2	4 1-4	1 1-4	6 00
*2 3-4	4	1 1-4	5 40
3	3 7-8	1 1-4	4 20
*3 1-4	3 3-4	1 1-4	3 90
*3 1-2	3 5-8	1 1-4	3 75
*3 3-4	3 1-2	1 1-4	3 60
4	3 3-8	1 1-4	3 30
*4 1-2	3 1-4	1 1-4	3 00
5	3 1-8	1 1-4	2 70
*5 1-2	2 7-8	1 1-4	2 50
6	2 3-4	1 1-16	2 35
7	2 5-8	1 1-16	2 20
8	2 1-2	1 1-16	2 05

Cutters marked * are not kept in stock but are made to order.

List continued on next page.

IMPROVED STOCKING CUTTERS.

FOR USE ON

No. 3 Automatic Gear Cutting Machines.

Diametral Pitch.	Diameter of Cutter.	Hole.	Price.
*4	3 1-2"	1"	$3 30
*4 1-2	3 3-8	1	3 00
5	3 1-4	1	2 70
*5 1-2	3 1-8	1	2 50
6	3	1	2 35
7	2 7-8	1	2 20
8	2 7-8	1	2 05

FOR USE ON

No. 4 Automatic Gear Cutting Machines.

Diametral Pitch.	Diameter of Cutter.	Hole.	Price.
*3	4 1-4"	1 1-4"	$4 50
*3 1-2	4	1 1-4	4 05
4	3 3-4	1 1-4	3 60
*4 1-2	3 3-4	1 1-4	3 30
5	3 5-8	1 1-4	3 15
*5 1-2	3 5-8	1 1-4	3 00
6	3 1-2	1 1-4	2 85
7	3 3-8	1 1-4	2 70
8	3 1-4	1 1-4	2 55

Cutters marked * are not kept in stock, but are made to order.

List continued on next page.

IMPROVED STOCKING CUTTERS—Continued.

FOR USE ON

No. 5 Automatic Gear Cutting Machines.

Diametral Pitch.	Diameter of Cutter.	Hole.	Price.
*2	5 3-4"	1 1-2"	$8 10
*2 1-4	5 1-2	1 1-2	7 35
*2 1-2	5	1 1-2	6 30
*2 3-4	4 3-4	1 1-2	5 70
3	4 3-4	1 1-2	4 80
*3 1-4	4 1-2	1 1-2	4 65
*3 1-2	4 3-8	1 1-2	4 35
*3 3-4	4 1-4	1 1-2	4 05
4	4 1-4	1 1-2	3 75
*4 1-2	4 1-8	1 1-2	3 45
5	4	1 1-2	3 15
*5 1-2	3 7-8	1 1-2	3 00
6	3 3-4	1 1-2	2 85
7	3 5-8	1 1-2	2 70
8	3 1-2	1 1-2	2 55

FOR USE ON

No. 6 Automatic Gear Cutting Machines.

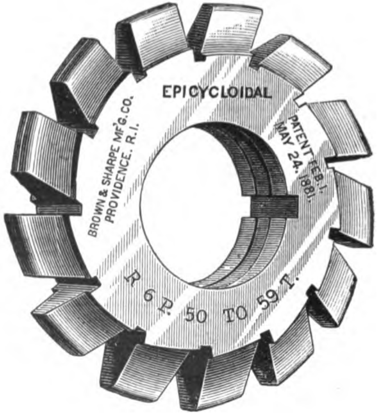
Diametral Pitch.	Diameter of Cutter.	Hole.	Price.
*1 3-4	6 1-2"	1 3-4"	$11 10
2	6 1-4	1 3-4	8 40
*2 1-4	6	1 3-4	7 65
2 1-2	5 3-4	1 3-4	6 60
*2 3-4	5 1-2	1 3-4	6 00
3	5 1-4	1 3-4	5 10
*3 1-4	5 1-8	1 3-4	4 95
*3 1-2	4 7-8	1 3-4	4 65
*3 3-4	4 3-4	1 3-4	4 35
4	4 5-8	1 3-4	4 05
*4 1-2	4 1-2	1 3-4	3 75
5	4 3-8	1 3-4	3 45
*5 1-2	4 3-8	1 3-4	3 45
6	4 1-4	1 3-4	3 30
*7	4 1-8	1 3-4	3 15
*8	4	1 3-4	3 00

Cutters marked * are not kept in stock, but are made to orde

PATENT EPICYCLOIDAL CUTTERS

FOR TEETH OF GEAR WHEELS.

Which can be Sharpened by Grinding without Changing their Form.



We furnish Cutters of Epicycloidal form, which are sharpened upon the face the same as the Involute Cutters. As gears of this form of teeth to run well must be cut accurately to the proper depth that the pitch lines may coincide, we make the cutters with a shoulder (see cut above), which determines the exact depth that the tooth should be cut. Care taken in sizing the blanks obviates the necessity of any measurements in cutting the teeth. The Cutters are made for either diametral or circular pitches and the same rules apply in finding the diameters of blanks as in our system of Involute teeth, *i. e.*, 2 pitches added to the diameter at pitch line. See formulas, pages 305 to 308, and tables showing corresponding circular and diametral pitches, page 284.

These Cutters will cut gears which are interchangeable.

The white line on edge of the two left hand upper teeth of cut represents a centre line on the cutter teeth, which may be a convenience in setting the cutter central.

The Cutters are marked with letters from A to X, by which they may be ordered. See following table for dimensions of Cutters and page 261 for directions etc.

PATENT EPICYCLOIDAL CUTTERS

For Teeth of Gear Wheels.

All Gears of same Pitch cut with these Cutters are interchangeable.

Diametral Pitch.	Diameter of Cutter.	Size of Hole in Cutter.	Price of Each Cutter.
*2	5"	1 1-4"	$15 50
*2 1-4	4 1-2	1 1-4	14 00
*2 1-2	4 1-4	1 1-4	13 00
*2 3-4	4	1 1-4	11 75
3	3 13-16	1 1-4	10 75
*3 1-2	3 9-16	1 1-4	9 75
4	3 3-8	1 1 4	6 60
5	3 1-16	1 1-4	5 65
6	2 3-4	1 1-16	4 65
*7	2 9-16	1 1-16	4 40
8	2 1 2	1 1-16	3 90
*9	2 3-8	1 1-16	3 65
10	2 1-8	7-8	3 40
*12	2	7-8	3 20
*14	2	7-8	3 00
*16	1 15-16	7-8	2 80

Cutters marked * are not kept in stock, but are made to order.

Cutters are Marked with Letters

24 Cutters in Each Set.

Cutter A cuts	12 teeth.	Cutter M cuts	27 to 29 teeth.
" B "	13 "	" N "	30 " 33 "
" C "	14 "	" O "	34 " 37 "
" D "	15 "	" P "	38 " 42 "
" E "	16 "	" Q "	43 " 49 "
" F "	17 "	" R "	50 " 59 "
" G "	18 "	" [illegible] "	60 " 74 [illegible]
" H "	19 "	" T "	75 " [illegible]
" I "	20 "	" [illegible]	[illegible]
" J "	21 to 22 "	[illegible]	[illegible]
" K "	23 to 24 "	[illegible]	[illegible]
" L "	25 to 26 "	[illegible]	[illegible]

In ordering give the [illegible] the [illegible] required.

CUTTERS FOR MITRE AND BEVEL GEARS.

Diametral Pitch	Diam. of Cutter.	Hole in Cutter.	Price of each Cutter
4	3 3-8"	1 1-4"	$5 50
5	3 1-16	1 1-4	4 50
6	2 3-4	1 1-16	3 90
7	2 9-16	1 1-16	3 60
8	2 1-2	1 1-16	3 40
10	2 1-8	7-8	3 00
12	2	7-8	2 65
14	2	7-8	2 55
16	1 15-16	7-8	2 45
20	1 7-8	7-8	2 30
24	1 3-4	7-8	2 10

These cutters are carried in stock.

Cutters for pitches not given in the above list will be made to order.

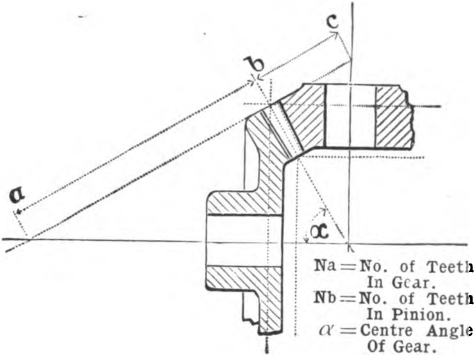
These cutters are thin enough to cut any bevel gear whose tooth face is not longer than one-third the distance from its outer end to the point where the shaft centre lines meet. This makes the tooth thickness at the inner end not less than two-thirds that at the outer end.

In ordering cutters for Bevel Gears, if the number of teeth in each gear, the pitch and length of face are given, also the angle of the shafts, if different from a right angle, we can select the proper cutter to send.

When an extra length of face is wanted, requiring an especially thin cutter, this length should be specified in the order.

Eight cutters are made for each pitch and numbered from 1 to 8.

As the number of teeth in the bevel gears to be cut with each cutter will not always agree with the list on page 262, the number of cutter must be found for each pair of gears to be cut according to the following diagram or formula.



Measure the back cone radius *a b* for the gear, or *b c* for the pinion. This is equal to the radius of a spur gear, the number of teeth in which would determine the cutter to use. Hence twice *a b* times the diametral pitch equals the number of teeth for which the cutter should be selected for the gear. Looking in the list on page 262 the proper number for the cutter can be found.

Thus, let the back cone radius *a b* be 4″ and the diametral pitch be 8. Twice 4 is 8 and 8 x 8 is 64, from which it can be seen that the cutter must be of shape No. 2, as 64 is between 55 and 134, the range covered by a No. 2 cutter.

The number of teeth for which the cutter should be selected can also be found by the following formula:

$$\text{Tan. } \alpha = \frac{\text{Na}}{\text{Nb}}$$

$$\text{No. of teeth to select cutter for gear} = \frac{\text{Na}}{\text{Cos. } \alpha}$$

$$\text{No. of teeth to select cutter for pinion} = \frac{\text{Nb}}{\text{Sin. } \alpha}$$

If the gears are mitres or are alike, only one cutter is needed; if one gear is larger than the other, two may be needed.

Additional helps on this subject can be found in B. & S. "Practical Treatise on Gearing," and "Formulas in Gearing."

For List of Publications, see page

THE SIZING AND CUTTING OF GEAR WHEELS.

The word "diameter" when applied to gears, is always understood to mean the pitch diameter.

Diametral pitch of the gear is the number of teeth to each inch of its pitch diameter.

If a gear has 40 teeth and the pitch diameter is 4 inches, there are 10 teeth to each inch of the pitch diameter, and the diametral pitch is 10, or in other words, the gear is 10 diametral pitch.

Circular pitch is the distance from the centre of one tooth to the centre of the next tooth, measured along the pitch circle.

If the distance from the centre of one tooth to the centre of next tooth, measured along the pitch circle, is 1-2 inch, the gear is 1-2 inch circular pitch.

The diametral pitch given, to obtain the circular pitch, divide 3.1416 by the diametral pitch.

If the diametral pitch is 4, divide 3.1416 by 4, and the quotient, .7854 inch, is the circular pitch.

The circular pitch given, to obtain the diametral pitch, divide 3.1416 by the circular pitch.

If the circular pitch is 2 inches, divide 3.1416 by 2 and the quotient, 1.5708, is the diametral pitch.

The number of teeth and the diametral pitch given, to obtain the pitch diameter, divide the number of teeth by the diametral pitch.

If the number of teeth is 40, and the diametral pitch is 4, divide 40 by 4, and the quotient, 10, is the pitch diameter.

The number of teeth and the diametral pitch given, to obtain the whole diameter or size of blank of gear, add 2 to the number of teeth and divide by the diametral pitch.

If the number of teeth is 40, and the diametral pitch is 4, add 2 to the 40, making 42, and divide by 4; the quotient, 10 1-2, is the whole diameter of the gear or blank.

The number of teeth and the diameter of the blank given, to obtain the diametral pitch, add 2 to the number of teeth, and divide by the diameter of the blank.

If the number of teeth is 40, the diameter of the blank is 10 1-2 inches, add 2 to the number of teeth, making 42, and divide by 10 1-2; the quotient, 4, is the diametral pitch.

The pitch diameter and the diametral pitch given, to obtain the number of teeth, multiply the pitch diameter by the diametral pitch.

If the diameter of the pitch circle is 10 inches, and the diametral pitch is 4, multiply 10 by 4, and the product, 40, will be the number of teeth in the gear.

The whole diameter of the blank and the diametral pitch given, to obtain the number of teeth in the gear, multiply the diameter by the diametral pitch and subtract 2.

If the whole diameter is 10 1-2, and the diametral pitch is 4, multiply 10 1-2 by 4, and the product, 42 less 2, or 40, is the number of teeth.

The thickness of a tooth at the pitch line is found by dividing the circular pitch by 2, or divide 1.57 by the diametral pitch.

If the circular pitch is 1.047 inch, or the diametral pitch is 3, divide 1.047 by 2, or 1.57 by 3, and the quotient; .523 inch, is the thickness of tooth.

The whole depth of a tooth is found by dividing 2.157 by the diametral pitch.

If the diametral pitch of a gear is 6, the whole depth is 2.157 divided by 6, equals .3595.

The whole depth of a tooth is about 11-16, or exactly .6866 of the circular pitch.

If the circular pitch is 2, the whole depth of tooth is about 11-16 of 2 inches, or 1 3-8 inches nearly.

The distance between the centres of two gears is found by adding the number of teeth together, and dividing half the sum by the diametral pitch.

If two gears have 50 and 30 teeth, respectively, and are 5 pitch, add 50 and 30, making 80, divide by 2, and then divide the quotient, 40, by the diametral pitch, 5, and the result, 8 inches, is the centre distance.

To facilitate the measurement of wheels to be sized according to diametral pitch, either of the following steel rules described can be used. No. 61 is a twelve inch rule containing four lines of graduations upon each side, one each as follows: 18ths, 20ths, 22nds, 24ths, 26ths, 28ths, 30ths and 32nds. Each line of graduations is figured the whole length of the rule, 10, 20, 30, &c. Suppose a wheel of 60 teeth of 20 pitch is to be sized, then find 60 on the line of 20ths and that is the *pitch* diameter of the required wheel; then add two of the divisions to make the *outside* diameter which is sixty-two twentieths. No. 78 is also a 12-inch rule having one inch only of graduations on each end as follows: 6ths, 7ths, 8ths, 9ths, 10ths, 11ths, 12ths, 14ths, 16ths, 18ths, 20ths, 22nds, 24ths, 26ths, 28ths, 30ths, 32nds, 34ths, 36ths, 38ths. The intermediate ten inches are blank, except that the inch lines are made clear across the rule. Suppose a wheel of 83 teeth of 10 pitch is to be sized, then take 8 of the blank inches and three of the 10th graduations and that gives the pitch diameter of the required wheel, add two of the tenths which gives the *outside* diameter which is eight and five-tenths inches.

This rule furnishes graduations for a large variety of pitches and is the best adapted for the use for which it is designed. In add[illegible]ove are made 12 and 24 inch rules with No. 5 [illegible]ows:

1st corner, 11, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25.
2nd " 16, 32, 64.
3rd " 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38.
4th " 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 100.

ON PAGES 305 TO 308, FORMULAS AND EXAMPLES ARE GIVEN FOR ALL CALCULATIONS REQUIRED IN CONNECTION WITH SIZE AND PITCH OF WHEELS. *For prices of Steel Rules described on preceding page, see page* 397.

No. 1 table shows the diametral pitches with the corresponding circular pitches.

No. 2 table shows the circular pitches with the corresponding diametral pitches.

TABLE No. 1.		TABLE No. 2.	
Diametral Pitch.	Circular Pitch.	Circular Pitch.	Diametral Pitch.
1 1-4	2.5133"	2"	1.571
1 1-2	2.0944	1 7-8	1.676
1 3-4	1.7952	1 3-4	1.795
2	1.571	1 5-8	1.933
2 1-4	1.396	1 1-2	2.094
2 1-2	1.257	1 7-16	2.185
2 3-4	1.142	1 3-8	2.285
3	1.047	1 5-16	2.394
3 1-2	.898	1 1-4	2.513
4	.785	1 3-16	2.646
5	.628	1 1-8	2.793
6	.524	1 1-16	2.957
7	.449	1	3.142
8	.393	15-16	3.351
9	.349	7-8	3.590
10	.314	13-16	3.867
11	.286	3-4	4.189
12	.262	11-16	4.570
14	.224	5-8	5.027
16	.196	9-16	5.585
18	.175	1-2	6.283
20	.157	7-16	7.181
22	.143	3-8	8.378
24	.131	5-16	10.053
26	.121	1-4	12.566
28	.112	3-16	16.755
30	.105	1-8	25.133
32	.098	1-16	50.266
36	.087		
40	.079		
48	.065		

According to the system adopted by the Brown & Sharpe Mfg. Co., any wheel of one pitch will gear into any other wheel or into a rack of the same pitch. *Eight cutters are required for each pitch.* These eight cutters are adapted to cut from a pinion of twelve teeth to a rack, and are numbered respectively, 1, 2, 3, &c. The number of teeth and the pitch for which a cutter is adapted is also marked on each

No. 1	will cut wheels	from	135	teeth to	a rack.	
" 2	"	"	55	"	134	teeth.
" 3	"	"	35	"	54	"
" 4	"	"	26	"	34	"
" 5	"	"	21	"	25	"
" 6	"	"	17	"	20	"
" 7	"	"	14	"	16	"
" 8	"	"	12	"	13	"

If a cutter is wanted for a wheel of 40 teeth of 8 pitch, then the cutter required, would be No. 3 of 8 pitch, inasmuch as a No. 3 cutter will cut all wheels containing from 35 to 54 teeth, inclusive, and 40 occuring between those numbers, that is the one desired. It should be borne in mind that eight different cutters are required in order to cut all the wheels of any given pitch. Directions for the use of these cutters will be found upon pages 261 and 262. Special attention is called to the clause upon page 262 in relation to depth of space.

As these cutters allow of being ground when dull, it is important that they be *kept sharp*. By paying particular attention to this the cutting will be greatly facilitated beside being much better done.

It is desirable in applying gearing of any kind, to avoid having wheels or pinions with a small number of teeth. Pinions of twelve teeth will work very well but a less number of teeth should not be used.

Few mechanics are familiar with the minutiae of gearing and the necessity of exact sizing of wheels, as to diameter, is often overlooked. Special care is required also to know that the distance of the centres of two wheels running together is correct relatively to the diameters.

TABLE showing Depth of Space and Thickness of Tooth in Spur Wheels, when cut with our Patent Cutters.

Pitch of Cutter.	Depth to be cut in Gear.	Thickness of Tooth at Pitch Line.	Pitch of Cutter.	Depth to be cut in Gear.	Thickness of Tooth at Pitch Line.
1 1-4	1.726"	1.257"	11	.196"	.143"
1 1-2	1.488	1.047	12	.180	.131
1 3-4	1.233	.898	14	.154	.112
2	1.078	.785	16	.135	.098
2 1-4	.958	.697	18	.120	.087
2 1-2	.863	.628	20	.108	.079
2 3-4	.784	.570	22	.098	.071
3	.719	.523	24	.090	.065
3 1-2	.616	.448	26	.083	.060
4	.539	.393	28	.077	.056
5	.431	.314	30	.072	.052
6	.359	.262	32	.067	.049
7	.308	.224	36	.060	.044
8	.270	.196	40	.054	.039
9	.240	.175	48	.045	.033
10	.216	.157			

TOOTH FLANKS UNDERCUT.

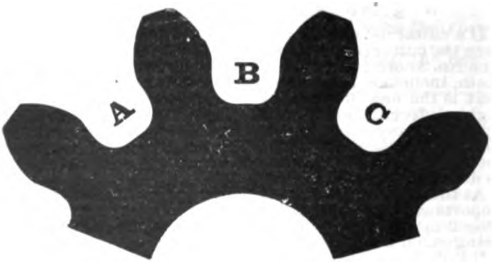


Fig. 1.

Fig. 2.

TOOTH FLANKS UNDERCUT.

It is well known that involute gears can be made of different systems or of different angles of obliquity or pressure. In the system proposed by Professor Willis about fifty years ago, which we adopted thirty years ago, the angle of pressure, or obliquity, is fourteen and a half degrees. Twice this angle is the familiar angle of a worm thread tool the same as seen in our gauge, on page 441. Gears made upon this system are thought to crowd less upon their shafts than those having a greater angle of pressure. If, however, a gear or pinion has fewer than twelve teeth, this angle may cause their flanks to be undercut and in consequence weak in order to clear the faces of an engaging gear. The cut of a segment of a gear of ten teeth, four diametral pitch, Fig. 1, illustrates this undercutting which is greater as the teeth are fewer.

Gears or pinions, having fewer than twelve teeth might be unavailable if undercut as much as at A, B and C, in the illustration Fig. 1. Hence, gears that are to do heavy work may require a greater angle of pressure than fourteen and a half degrees, if they are to run with a pinion of fewer than twelve teeth.

If a different angle is required, special cutters will have to be made at an extra cost.

In the choice of an angle of pressure some help may be obtained from Fig. 2, which is taken from a gear 10 teeth, 4 pitch. The angle of pressure in these teeth is 22 1-2°. The greater strength of the tooth flanks in this figure is readily seen. The angle cannot be much more than thirty-two degrees and have the addendum of the teeth of the ordinary height, which is equal to one of the diameter pitches or the module.

COMPARATIVE SIZES OF GEAR TEETH.

Involute.

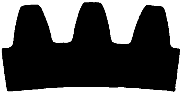
20 P

18 P

16 P

14 P

12 P



10 P

9 P

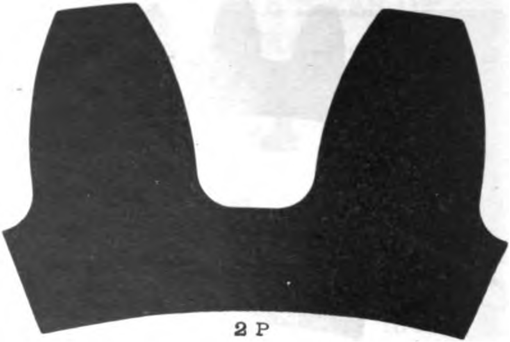
8 P

7 P

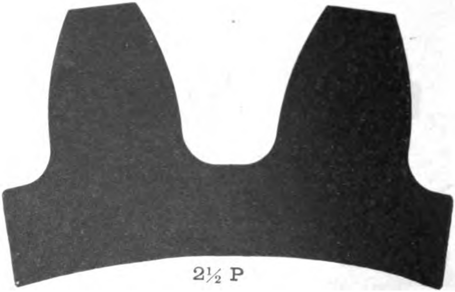
6 P

5 P

4 P



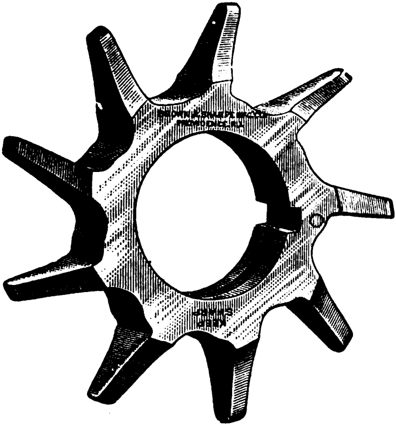
2 P



2½ P

3 P

KEEP CUTTERS SHARP.



This Cutter has cut 467, 4 pitch, 64 teeth, 3″ face cast iron gears, making a total length of cut of 7472 feet. The teeth of the gears were cut from solid blanks, and finished at one cut. This record, while good, is not exceptional, and serves to show the great economy of keeping *cutters sharp*.

WORM WHEEL CUTTERS.

Cutters of any given diameter and pitch for Cutting Worm Wheels are made to order. In ordering Cutters for Worm Wheels, give the *number of teeth in wheel*, *the diameter of worm and number of threads to the inch*.

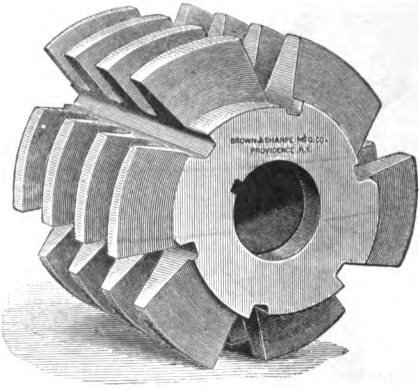
SPECIAL GEAR CUTTERS.

Worm Wheel Cutters and Cutters of special dimensions are made to order at special prices.

Spur and Bevel Gear Cutters, shown in lists, when ordered with special size hole, are made to order at an advance of fifty cents each on list price. If six or more of one pitch are ordered with special size hole, the list price is charged.

WORM HOBS

With Relieved Teeth.



We are prepared by the use of special machinery, to make Worm Hobs of any size, the teeth of which can be ground on their faces without changing their form.

By our method of relieving hobs, they cut as freely as milling cutters and are sharpened in the same manner as our formed milling cutters.

We usually make the hobs a sufficient amount larger than the worm to give clearance to the top of the teeth and to allow a reasonable amount for the grinding of the teeth without reducing the diameter of the hub to less than that of the worm.

Ordering Hobs. In ordering hobs the following data should be given: the outside diameter of the worm, number of teeth in worm wheel, the lead, i. e., the advance to one turn, whether the thread is single, double etc., right or left hand, diameter of hole, size of key-way and material to be cut, also whether the wheel to be hobbed is driven by the hob or by the hobbing machine spindle.

If the nature of the work requires a hob of exact diameter, it should be plainly stated when ordering, otherwise the allowance mentioned above will be added.

LIST OF WORM HOBS.

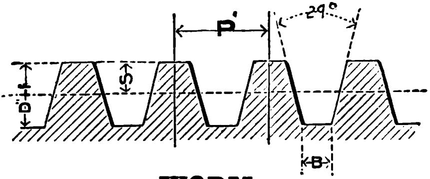
The following is a list of the hobs we have on hand to hob worm wheels.

These Hobs are not for sale, but are kept on hand for the convenience of our customers.

Customers will find it to their advantage as to time and expense, in ordering worm wheels for us to hob, if they can make use of these hobs.

In this list

Lead = advance in one revolution.
Pitch, P′, and Lead of single hobs are equal.
Pitch, P′, of double hob = 1-2 the lead.
Turns per inch = 1 divided by lead.



WORM.

B = .31 P′.

D″ + f = .6866 P′. S = .3183 P′.

Single Threaded.

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P′.	Pitch Diam. of Worm.
.050	20	R	.3125″	.0500	.2807″
.100	10	R	.625	.1000	.5614
.100	10	L	.625	.100	.5614
.100	10	R	.750	.1000	.6864
.100	10	L	.7337	.1000	.6700
.100	10	R	1.676	.1000	.6124
.125	8	R	.573	.125	.4934
.125	8	R	.875	.1250	.7954
.125	8	L	1.00	.1250	.9204
.125	8	R	1.00	.1250	.9204
.125	8	R	1.270	.1250	1.1904
.133	7 1-2	R	1.00	.1333	.9152
.133	7 1-2	R	1.1250	.1333	1.0402
.143	7	R	.690	.1428	.5990
.150	6 2-3	R	1.215	.150	1.1196
.154	6.536	R	1.125	.1538	1.0276
.156	6 2-5	L	1.288	.1562	1.1886
.166	6	R	.875	.1666	.7688
.166	6	R	1.00	.1666	.8938
.166	6	L	1.00	.1666	.8938
.166	6	R	1.204	.1666	1.0978

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P'.	Pitch Diam. of Worm.
.166	6	R	1.250″	.1666	1.1438″
.166	6	L	1.400	.1666	1.2938
.166	6	R	1.500	.1666	1.3940
.166	6	R	1.625	.1666	1.5188
.166	6	L	1.625	.1666	1.5188
.166	6	L	1.750	.1666	1.6438
.166	6	R	2.	.1666	1.8938
.166	6	R	2.056	.1666	1.9498
.166	6	R	2.109	.1666	2.0028
.166	6	R	2.15625	.1666	2.0500
.200	5	R	1.00	.2000	.8726
.200	5	L	1.250	.2000	1.1226
.200	5	R	1.250	.2000	1.1226
.200	5	L	1.480	.2000	1.3526
.200	5	R	1.500	.2000	1.3726
.200	5	R	1.5625	.2000	1.4351
.200	5	R	1.750	.2000	1.6226
.200	5	R	1.9375	.2000	1.8101
.200	5	L	2.000	.2000	1.8727
.222	4 1-2	L	.974	.2222	.8326
.222	4 1-2	R	1.250	.2222	1.1086
.222	4 1-2	R	1.397	.2222	1.2556
.222	4 1-2	R	1.437	.2222	1.2956
.222	4 1-2	R	1.500	.2222	1.3586
.222	4 1-2	L	1.500	.2222	1.3586
.222	4 1-2	R	1.750	.2222	1.6086
.222	4 1-2	R	1.88	.2222	1.7386
.222	4 1-2	L	1.88	.2222	1.7386
.222	4 1-2	R	2.	.2222	1.8586
.222	4 1-2	L	2.	.2222	1.8586
.222	4 1-2	R	2.375	.2222	2.2336
.235	4.255	R	2.375	.2353	2.2254
.250	4	L	1.	.2500	.8410
.250	4	R	1.0625	.2500	.9033
.250	4	R	1.250	.2500	1.0908
.250	4	L	1.399	.2500	1.2399
.250	4	L	1.250	.2500	1.0908
.250	4	L	1.500	.2500	1.3408
.250	4	R	1.500	.2500	1.3408
.250	4	R	1.5625	.2500	1.4033
.250	4	L	1.625	.2500	1.4658
.250	4	R	1.625	.2500	1.4658
.250	4	R	1.7187	.2500	1.5588
.250	4	R	1.750	.2500	1.5908
.250	4	L	1.750	.2500	1.5908
.250	4	R	2.	.2500	1.8408
.250	4	L	2.	.2500	1.8408
.250	4	R	2.025	.2500	1.8658
.250	4	R	2.250	.2500	2.0[illegible]8
.250	4	R	2.500	.2500	2.3[illegible]8
.2618	3.820	R	1.521	.2618	1.[illegible]44
.286	3 1-2	R	1.467	.2857	1.[illegible]2
.286	3 1-2	L	1.750	.286	1.[illegible]
.286	3 1-2	R	2.125	.286	1.[illegible]

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P'.	Pitch Diam. of Worm.
.286	3 1-2	R	2.500″	.2857	2.3182″
.300	3 1-3	L	1.461	.3000	1.2702
.300	3 1-3	R	3.065	.3000	2.874
.3125	3.2	L	1.75	.3125	1.5510
.3142	3.183	L	1.700	.3142	1.5000
.3142	3.183	R	2.	.3142	1.8000
.333	3	R	1.250	.3333	1.0378
.333	3	L	1.532	.3333	1.3198
.333	3	R	1.750	.3333	1.5378
.333	3	R	1.908	.3333	1.6958
.333	3	L	1.908	.3333	1.6958
.333	3	R	1.968	.3333	1.7558
.333	3	R	1.977	.3333	1.7648
.333	3	R	2.250	.3333	2.0378
.333	3	L	2.250	.3333	2.0378
.333	3	R	2.500	.3333	2.2878
.333	3	L	2.500	.3333	2.2878
.333	3	R	3.	.3333	2.7878
.349	2.865	R	1.875	.3491	1.6528
.353	2 10-12	R	2.250	.3533	2.0251
.353	2 10-12	L	2.250	.3533	2.0250
.375	2 2-3	R	1.125	.3750	.8862
.375	2 2-3	R	1.8125	.3750	1.5737
.375	2 2-3	L	1.875	.3750	1.6362
.375	2 2-3	R	2 250	.3750	2.0113
.375	2 2-3	R	3.	.3750	2.7612
.380	2.632	L	2.375	.380	2.1330
.3927	2.546	R	2.000	.3927	1.7500
.3927	2.546	R	2.250	.3927	2.000
.3927	2.546	L	2.750	.3927	2.500
.3927	2.546	R	3.000	.3927	2.750
.3927	2.546	L	3.000	.3927	2.750
.3927	2.546	R	4.250	.3927	4.0000
.3927	2.546	L	4.250	.3927	4.0000
.3927	2.546	R	5.250	.3927	5.000
.400	2 1-2	R	1.50	.4000	1.2454
.400	2 1-2	L	1.750	.4000	1.4954
.400	2 1-2	L	1.914	.4000	1.6594
.400	2 1-2	R	2.	.4000	1.7454
.400	2 1-2	L	2.125	.4000	1.8704
.400	2 1-2	R	2.162	.4000	1.9074
.400	2 1-2	R	2.250	.4000	1.9954
.444	2 1-4	R	2.6875	.4444	2.4047
.444	2 1-4	L	2.6875	.4444	2.4047
.4488	2.228	R	4.000	.4488	3.7143
.500	2	R	1.537	.5000	1.218[illegible]
.500	2	R	1.8125	.5000	1.4[illegible]
.500	2	R	1.880	.5000	[illegible]
.500	2	R	1.537	.5000	[illegible]
.500	2	R	1.8125	.5000	[illegible]
.500	2	R	1.880	.5000	[illegible]
.500	2	R	2.0625	.5000	[illegible]
.500	2	R	2.112	.5000	[illegible]
.500	2	L	2.1875	.5000	1.[illegible]

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P′.	Pitch Diam. of Worm.
.500	2	R	2.192″	.5000	1.8736″
.500	2	R	2.250	.5000	1.9316
.500	2	R	2.500	.5000	2.1816
.500	2	L	2.500	.5000	2.1816
.500	2	R	2.75	.5000	2.4316
.500	2	R	3.	.5000	2.6816
.500	2	L	3.	.5000	2.6816
.500	2	R	3.25	.5000	2.9316
.5236	1.9098	R	2.833	.5236	2.5000
.5236	1.9098	R	3.250	.5236	2.9167
.596	1.678	L	4.879	.596	4.5000
.625	1 3-5	R	2.0318	.6250	1.6340
.625	1 3-5	L	2.951	.6250	2.5532
.625	1 3-5	R	3.500	.6250	3.1022
.625	1 3-5	L	3.500	.6250	3.1022
.6283	1.591	L	2.75	.6283	2.3500
.6283	1.591	R	3.000	.6283	2.6000
.632	1.583	R	4.9021	.6317	4.5000
.632	1.583	L	4.902	.6317	4.5000
.666	1 1-2	R	2.740	.6666	2.3156
.666	1 1-2	R	2.750	.6666	2.3256
.714	1 2-5	R	3.	.7143	2.5450
.750	1 1-3	R	2.725	.7500	2.2476
.750	1 1-3	R	2.896	.750	2.4185
.750	1 1-3	R	2.977	.7500	2.4996
.750	1 1-3	R	3.00	.7500	2.5226
.750	1 1-3	R	3.075	.7500	2.5976
.750	1 1-3	R	3.625	.7500	3.1476
.750	1 1-3	R	4.	.7500	3.5226
.750	1 1-3	L	4.	.7500	3.5226
.7854	1.273	R	3.500	.7854	3.0000
.875	1 1-7	L	5.208	.875	4.6510
1.000	1	R	3.66	1.0000	3.0234
1.000	1	L	3.750	1.0000	3.1134
1.000	1	R	2.875	1.0000	2.2384
1.000	1	R	3.500	1.0000	2.8634
1.000	1	R	3.886	1.0000	3.249
1.000	1	R	4.218	1.0000	3.5814
1.125	8-9	R	5.01	1.1250	[illegible]
1.250	4-5	R	3.5625	1.2500	[illegible]
1.250	4-5	R	4.450	1.2500	[illegible]
1.250	4-5	R	5.375	1.2500	[illegible]
1.375	8-11	L	4.0625	1.3750	[illegible]
1.375	8-11	R	4.616	1.3750	[illegible]
1.500	2-3	R	4.865	1.5000	[illegible]
1.500	2-3	R	5.400	1.5000	[illegible]
1.500	2-3	L	5.454	1.5000	[illegible]
1.500	2-3	R	5.474	1.500	[illegible]
1.500	2-3	R	6.754	1.5000	[illegible]
1.625	8-13	R	4.500	[illegible]	[illegible]
1.625	8-13	L	4.500	[illegible]	[illegible]
1.750	4-7	R	5.763	[illegible]	[illegible]
1.875	.5333	R	6.943	[illegible]	[illegible]
2.000	1-2	R	5.491	[illegible]	[illegible]

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P′.	Pitch Diam. of Worm.
2.000	1-2	L	5.750″	2.0000	4.4768″
2.000	1-2	R	7.750	2.0000	6.4768

Double Threaded.

.200	5	R	.750″	.1000	.6864″
.250	4	R	.653	.125	.5734
.333	3	R	2.250	.1666	2.1438
.400	2 1-2	R	1.125	.2000	.9977
.400	2 1-2	R	1.250	.2000	1.1227
.400	2 1-2	R	1.45	.2000	1.3226
.400	2 1-2	L	1.480	.2000	1.3526
.400	2 1-2	L	2.	.2000	1.8726
.444	2 1-4	R	1.125	.222	.9836
.444	2 1-4	L	1.500	.222	1.3586
.444	2 1-4	L	2.	.2222	1.8586
.500	2	L	1.	.2500	.8408
.500	2	R	1.0634	.2500	.9042
.500	2	R	1.150	.2500	.9908
.500	2	L	1.150	.2500	.9908
.500	2	R	1.500	.2500	1.3408
.500	2	R	1.750	.2500	1.5908
.500	2	L	1.750	.2500	1.5908
.500	2	L	1.836	.2500	1.6768
.500	2	R	1.875	.2500	1.7158
.500	2	R	2.	.2500	1.8408
.500	2	R	3.485	.2500	3.3258
.5236	1.9098	R	2.500	.2618	2.3334
.571	1 3-4	R	1.250	.2850	1.0681
.571	1 3-4	R	1.500	.2857	1.3182
.625	1 3-5	R	1.250	.3125	1.0512
.625	1 3-5	L	1.250	.3125	1.0512
.625	1 3-5	L	2.405	.3125	2.206
.6283	1.591	L	1.700	.3141	1.500
.6283	1.591	R	1.700	.3141	1.500
.6283	1.591	L	2.200	.3141	2.000
.666	1 1-2	R	1.500	.3333	1.2878
.666	1 1-2	L	1.750	.3333	1.5378
.666	1 1-2	R	1.8750	.3333	1.6628
.666	1 1-2	R	2.000	.3333	1.7878
.666	1 1-2	L	2.000	.3333	.7878
.666	1 1-2	L	2.125	.3333	1.9128
.666	1 1-2	R	2.21	.3333	1.9978
.666	1 1-2	R	2.750	.3333	2.5378
.666	1 1-2	R	3.5333	[illegible]	3.3709
.6956	1.437	R	2.160	[illegible]	1.9386
.7272	1.375	L	1.750	[illegible]	1.5186
.750	1 1-3	R	1.375	[illegible]	1.1362
.750	1 1-3	R	[illegible]	[illegible]	2.0112
.750	1 1-3	L	[illegible]	[illegible]	2.2612
.750	1 1-3	R	[illegible]	[illegible]	[illegible]
.762	1.312	R	[illegible]	[illegible]	[illegible]

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P'.	Pitch Diam. of Worm.
.787	1.271	L	2.500″	.3934	2.2496″
.800	1 1-4	R	1.500	.4000	1.2454
.800	1 1-4	L	2.250	.4000	2.2454
.875	1 1-7	R	2.480	.4375	2.2014
.888	1 1-8	L	2.6875	.4440	2.4047
1.000	1	R	2.3180	.5000	2.000
1.000	1	R	2.750	.500	2.4316
1.000	1.	R	3.000	.5000	2.6816
1.250	4-5	R	3.3978	.6250	3.0000
1.250	4-5	R	2.500	.6250	2.1022
1.250	4-5	L	2.500	.6250	2.1022
1.250	4-5	L	3.404	.6250	3.0061
1.256	.796	L	3.20	.6280	2.8000
1.333	3-4	L	2.750	.6666	2.3256
1.333	3-4	R	3.500	.6666	3.0756
1.375	8-11	R	3.061	.6875	2.6234
1.500	2-3	R	2.771	.7500	2.2936
1.500	2-3	R	2.875	.7500	2.3976
1.500	2-3	R	3.609	.7500	3.1316
1.500	2-3	L	3.625	.7500	3.1476
1.500	2-3	R	4.500	.7500	4.0225
2.000	1-2	L	3.1875	1.0000	2.5509
2.000	1-2	L	3.8125	1.0000	3.1759
2.000	1-2	R	4.636	1.0000	4.0000
2.094	.4775	L	3.666	1.047	3.0000
2.500	2-5	R	4.450	1.250	3.6542
3.000	1-3	L	5.375	1.500	4.4202
3.000	1-3	L	5.978	1.5000	5.0232
3.000	1-3	R	5.978	1.5000	5.0230
3.500	2-7	R	8.556	1.7500	7.4420

Triple Threaded.

.375	2 2-3	L	.4766″	.125	.397″
.375	2 2-3	R	1.125	.1250	1.0454
.500	2	L	1.250	.1666	1.1439
.600	1 2-3	L	1.500	.2000	1.3726
.6732	1.485	R	.857	.2244	.7142
.750	1 1-3	L	.954	.2500	.7948
.750	1 1-3	L	1.488	.2500	1.3280
.750	1 1-3	R	1.500	.2500	1.3406
.750	1 1-3	R	2.000	.2500	1.8409
.750	1 1-3	R	2.698	.2500	2.5389
.857	1 1-6	R	2.193	.2857	2.0111
.9423	1.0612	R	2.200	.3142	2.0000
1.000	1	R	1.500	.3333	1.2878
1.000	1	L	1.750	.3333	1.5378
1.000	1	R	2.000	.3333	1.7878
1.000	1	L	2.000	.3333	1.7878
1.000	1	L	2.500	.3333	2.2878
1.125	8-9	R	2.000	.3750	1.7613
1.125	8-9	R	2.62	.3750	2.3813
1.333	3-4	L	2.000	.4444	1.7172

Lead.	Turns per Inch.	Right or Left.	Diam. of Worm.	Pitch P'.	Pitch Diam. of Worm.
1.333	3-4	R	2.625"	.4444	2.3422"
1.500	2-3	L	2.250	.5000	1.9316
1.500	2-3	R	2.354	.5000	2.0356
1.500	2-3	R	2.424	.5000	2.1057
1.500	2-3	R	2.637	.5000	2.3186
1.500	2-3	R	2.750	.5000	2.4316
1.500	2-3	R	3.	.5000	2.6816
1.875	8-15	R	3.500	.625	3.1021
2.250	4-9	R	3.625	.7500	3.1480
3.000	1-3	R	3.500	1.0000	2.8634
3.000	1-3	R	4.085	1.0000	3.4484
3.000	1-3	R	4.980	1.000	4.3434
3.375	.296	R	5.966	1.125	5.2500
4.125	.242	R	4.500	1.3750	3.6246
Quadruple Threaded.					
.4654	2.148	R	1.0236"	.11635	.9496"
.800	1 1-4	L	1.125	.2000	.9977
.9412	1 1-16	L	1.918	.2353	1.7684
1.000	1	R	1.500	.2500	1.3408
1.000	1	L	1.500	.2500	1.3408
1.000	1	L	1.750	.2500	1.5908
1.0472	.9549	L	2.250	.2618	2 0833
1.333	3-4	R	1.500	.3333	1.2878
1.333	3-4	L	1.625	.3333	1.4128
1.333	3-4	R	2.000	.3333	1.7878
1.3333	3-4	L	2.000	.3333	1.7878
1.333	3-4	R	2.500	.3333	2.2878
1.143	7-8	R	1.250	.2857	1.0682
2.000	1-2	R	2.750	.5000	2.4316
2.000	1-2	R	3.000	.5000	2.6816
2.000	1-2	L	3.000	.5000	2.6816
2.5132	.3978	L	3.150	.6283	2.7500
2.666	3-8	R	2.674	.6666	2.2500
2.666	3-8	R	2.6875	.6666	2.2631
4.000	1-4	L	5.000	1.000	4.3633
6.000	1-6	R	4.500	1.5000	3.5450
Quintuple Threaded.					
1.875	8.15	R	2.000"	.375	[illegible]
Sextuple Threaded.					
3.000	1-3	R	2.625"	.5000	[illegible]
3.000	1-3	R	2.500	.500	[illegible]

INDEX PLATES.

Made and Drilled to Order.

We make to order Index Plates of any size, drilled as may be required. Dimensions required: outside diameter, distance from face to bottom of hub, outside diameter of hub, diameter of hole in hub.

We have on hand patterns for Standard Index Plates, 12", 16" and 20" in diameter. These plates have ribs on the under side, and the edges are of a suitable form for cutting to receive a worm.

In sending Index Plates to be drilled, the following instructions should be noted: The surface of the plate should not have lines or marks upon it and should be left unpolished. The side of the plate to be drilled should be plainly indicated and, if to be figured, the manner in which this is to be done and whether to read from the outside of the plate or otherwise. If the edge of the plate is to be cut for a worm, we prefer to make the worm, as usually the results will be more satisfactory.

Prices on application.

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To Order.

All varieties of spur and bevel gears, herring bone, internal, spiral worms, intermittent spur and bevel, also rosettes for jewelers and watch case machine engine lathes.

GEAR WHEEL PATTERNS.

We can furnish gear wheel patterns to o[illegible] internal, spur or bevel.

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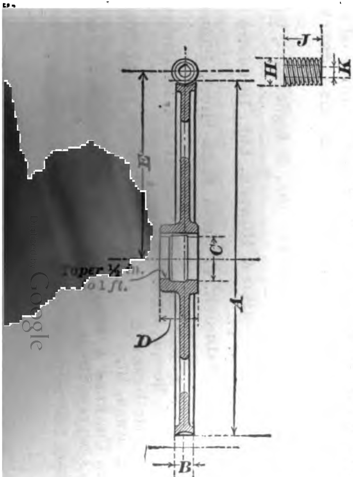
INDEX WHEELS AND WORMS.



We carry in stock accurately cut Index Wheels and Worms, as listed below.

Each Wheel has 240 teeth.

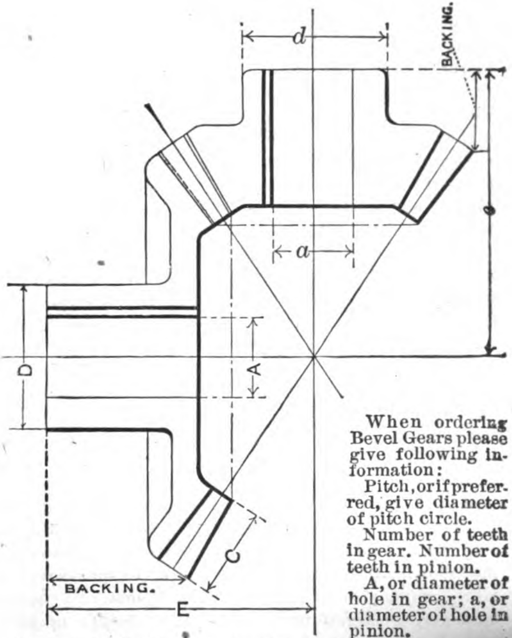
Each Worm is right hand, double threaded and revolves 120 times to 1 revolution of the Wheel.

Other sizes of Index Wheels and Worms can be furnished if desired.

Prices on application.

WHEEL.						WORM.			
Circular Pitch P'.	Diameter A.	Face B.	Hole C.	Length of Hub D.	Centre Distance E.	Diameter H.	Lead.	Length J.	Hole K.
.25	19.258	1 5-8"	2 1-2"	3"	10.595	2 1-4"	.500	2 1-4"	1"
.333	25.676	1 3-4	3 3-8	3 3-8	13.876	2 1-2	.666	3	1 1-16
.444	34.238	1 7-8	4 3-8	3 3-4	18.180	2 11-16	.888	3 3-4	1 1-8
.5714	44.02	2 3-8	5 3-8	4 1-2	23.146	3	1.142	4 1-2	1 1-4

INSTRUCTIONS FOR ORDERING BEVEL GEARS.



When ordering Bevel Gears please give following information:

Pitch, or if preferred, give diameter of pitch circle.

Number of teeth in gear. Number of teeth in pinion.

A, or diameter of hole in gear; a, or diameter of hole in pinion.

Backing for both gear and pinion.

C, or width of face.

D, or diameter of gear hub; d, or diameter of pinion h if these dimensions are of importance.

E, or distance from centre of pinion shaft to end of or distance from centre of gear shaft to end of pin

Key way, or set screw, and what size?

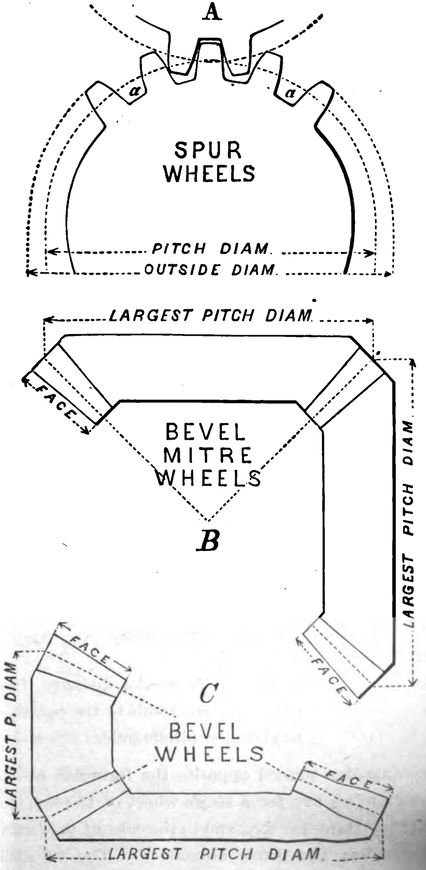
To be used for pattern or not?

Does the pinion drive or is it driven?

Unless otherwise specified face and ends of h be finished, and stock will be left on ends of hub

BEVEL GEARS.

The curve of teeth in Bevel Gears, when correctly formed, changes constantly from one end of the tooth to the other. Therefore bevel gears, whose teeth are produced with a cutter of fixed curve, are not theoretically correct, the cutter usually being of a curve that will make the correct form at the outer part of the face of the gear, and of necessity will leave the curves too large at the inside ends of the teeth. Small bevel gearing is almost universally produced in this manner, which practically answers the purpose, except when the teeth are very coarse or the gears very small, in which cases their operation is not satisfactory. In place of cutting by changing position of cutter, etc., the teeth are often filed slightly, in order to round them off to the curve required for their free running. On all bevel gears cut with a cutter of fixed curve, it is necessary to cut through *twice*, owing to the necessity of making the thickness of the cutter on the pitch line equal to about .005" thinner than the space between the teeth at the smallest *Pitch* diameter. As the width of space between the teeth on the largest pitch diameter should be greater than the thickness of the cutter, it must be made so by passing the cutter through the second time. For directions in ordering cutters for bevel gears, see pages 280 and 281. The cuts on the following page will explain the forms of spur, bevel and mitre gears, also the terms "pitch diameter," "outside diameter," "largest pitch diameter," "length of face," etc. When a pair of bevel gears are of same size and number of teeth, with their lines of centres at right angles, they are called "Mitre Gears," and one cutter will answer for both; but where one gear has a greater number of teeth, or differs in bevel from the one running into it, then each of the pair of gears may require a different cutter.


A
SPUR WHEELS
a
a
PITCH DIAM.
OUTSIDE DIAM.
LARGEST PITCH DIAM.
FACE
BEVEL MITRE WHEELS
B
LARGEST PITCH DIAM.
FACE
FACE
LARGEST P. DIAM.
C
BEVEL WHEELS
FACE
LARGEST PITCH DIAM.

FORMULAS

FOR

Determining the Dimensions of Gears by Diametral Pitch.

Let P denote the *diametral pitch*, or the number of teeth to one inch of diameter of pitch circle.

" D′	" the diameter of pitch circle.	*Larger Wheel.*	These wheels run together.
" D	" " whole diameter.		
" N	" " number of teeth.		
" V	" " velocity.		
" d′	" " diameter of pitch circle.	*Smaller Wheel.*	
" d	" " whole diameter.		
" n	" " number of teeth.		
" v	" " velocity.		

" a " " distance between the centres of the two wheels.
" b " " number of teeth in both wheels.
" t " " thickness of tooth or cutter on pitch circle.
" D″ " " working depth of tooth.
" f " " amount added to depth of tooth for rounding the corners and for clearance.
" D″+f " the whole depth of tooth.
" π constant 3.1416.
" P′ circular pitch or the distance from the centre of one tooth to the centre of the next on the pitch circle.

The examples placed opposite the formulas on the two pages following are for a *single* wheel of 12 pitch, 6.166 in. or 6 2-12 in. diameter &c., and in the case of the *two* wheels the larger has the *same* dimensions. The velocities are respectively 1 and 2.

FOR A SINGLE WHEEL.

FORMULAS. EXAMPLES.

$$P = \frac{N+2}{D} = \frac{72+2}{6.166}, \text{ or } \frac{72+2}{6\ 2\text{-}12} = 12.$$ 1.

$$P = \frac{N}{D'} = \frac{72}{6} = 12.$$ 2.

$$D' = \frac{D \times N}{N+2} = \frac{6.166 \times 72}{72+2} = 6.$$ 3.

$$D' = \frac{N}{P} = \frac{72}{12} = 6.$$ 4.

$$N = P\,D' = 12 \times 6 = 72.$$ 5.

$$N = P\,D - 2 = 12 \times 6.166 - 2, \text{ or } 12 \times 6\ 2\text{-}12 - 2 = 72.$$ 6.

$$D = \frac{N+2}{P} = \frac{72+2}{12} = 6.166, \text{ or } 6\ 2\text{-}12.$$ 7.

$$D = D' + \frac{2}{P} = 6 + \frac{2}{12}, \text{ or } 6 + .166 = 6.166.$$ 8.

$$t = \frac{1.57}{P} = \frac{1.57}{12} = .130.$$ 9.

$$D'' = \frac{2}{P} = \frac{2}{12} = .166, \text{ or } 2\text{-}12.$$ 10

$$f = \frac{t}{10} = \frac{.130}{10} = .013.$$ 11.

$$D'' + f = .166 + .013 = .179.$$ 12.

$$P' = \frac{\pi}{P} = \frac{3.1416}{12} = .262.$$ 13.

$$P = \frac{\pi}{P'} = \frac{3.1416}{.262} = 12.$$ 14.

FOR A PAIR OF WHEELS.

FORMULAS. EXAMPLES.

$b = 2\,a\,P = 2 \times 4.5 \times 12 = 108.$ 15.

$n = \dfrac{b\,V}{v + V} = \dfrac{108 \times 1}{3} = 36.$ 16.

$N = \dfrac{n\,v}{V} = \dfrac{36 \times 2}{1} = 72.$ 17.

$n = \dfrac{N\,V}{v} = \dfrac{72 \times 1}{2} = 36.$ 18.

$N = \dfrac{b\,v}{v + V} = \dfrac{108 \times 2}{3} = 72.$ 19.

$n = \dfrac{P\,D'\,V}{v} = \dfrac{12 \times 6 \times 1}{2} = 36.$ 20.

$V = \dfrac{n\,v}{N} = \dfrac{36 \times 2}{72} = 1.$ 21.

$v = \dfrac{N\,V}{n} = \dfrac{72 \times 1}{36} = 2.$ 22.

$v = \dfrac{P\,D'\,V}{n} = \dfrac{12 \times 6 \times 1}{36} = 2.$ 23.

$D = \dfrac{2\,a\,(N + 2)}{b} = \dfrac{2 \times 4.5 \times (72 + 2)}{108} = 6.166.$ 24.

$b = \dfrac{2\,a\,(n + 2)}{b} = \dfrac{2 \times 4.5 \times (36 + 2)}{108} = 3.166.$ 25.

$a = \dfrac{b}{2\,P} = \dfrac{108}{2 \times 12} = 4.5.$ 26.

$D' = \dfrac{2\,a\,v}{v + V} = \dfrac{2 \times 4.5 \times 2}{3} = 6.$ 27.

$d' = \dfrac{2\,a\,V}{v + V} = \dfrac{2 \times 4.5 \times 1}{3} = 3.$ 28.

$a = \dfrac{D' + d'}{2} = \dfrac{6 + 3}{2} = 4.5.$ 29.

PUBLICATIONS.

We issue the following copyrighted publications:

TREATISE ON MILLING MACHINES.

This work describes the construction and use of Milling Machines, as made by us. Fully illustrated. Sent by mail on receipt of price. Cardboard, 50 cents.

CONSTRUCTION AND USE OF UNIVERSAL GRINDING MACHINES.

Edition of 1901.

This work, recently revised, describes the construction and use of Universal Grinding Machines, as made by us. Fully illustrated. Sent by mail on receipt of price. Cardboard, 25 cents.

USE OF No. 13 UNIVERSAL AND TOOL GRINDING MACHINE.

This work describes the construction and use of the No. 13 Universal and Tool Grinding Machine, as made by us. Fully illustrated. Price, Cardboard, 25 cents.

USE OF PLAIN GRINDING MACHINES.

Edition of 1901.

This work describes the construction and use of Plain Grinding Machines, as made by us. Fully illustrated. Sent by mail on receipt of price. Cardboard, 25 cents.

PRACTICAL TREATISE ON GEARING.

Edition of 1902.

This book, with its tables and illustrations, is written for those in practical life, who wish to obtain practical explanations and directions in making Gear Wheels. Sent by mail on receipt of price. Cloth, $1.00; Cardboard, 75 cents.

FORMULAS IN GEARING.

Edition of 1900.

This work supplements the "Practical Treatise on Gearing" and contains formulas for solving the problems that occur in gearing. Sent by mail on receipt of price. Cloth, $1.50.

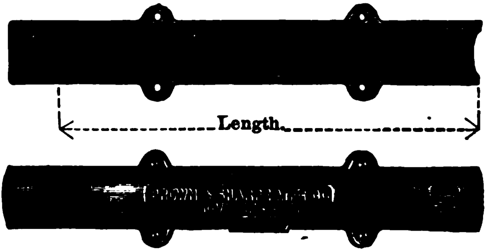
HAND BOOK FOR APPRENTICED MACHINISTS.

Edition of 1902.

This book, illustrated, is for learners in the use of Machine Tools. The present edition has been carefully revised and Sent by mail on receipt of price. Cloth, 50 cents.

CAST IRON CORE BOXES

For Foundry Use.

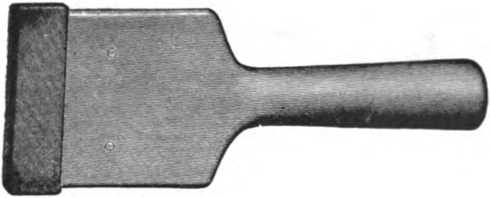


The advantages of the Cast Iron Core Boxes shown above are readily appreciated by every foundryman. They make solid cores, straight, round and true, are made as light as possible, consistent with the hard usage to which such tools are many times subjected, turned true and of standard size. The tapers in ends of boxes are all standard and the pins, for holding the halves in place, are of such form that the box is easily parted and still held firmly in place when together. Each half of every box is plainly marked with its size, so that any size desired can be picked out at a glance.

PRICE.

Size.	Price.	Length	Size.	Price.	Length
1-2"	$ 70	5"	1 1-8"	$1 20	9 7-8"
5-8	80	6	1 1-4	1 30	10 5-8
3-4	90	7	1 3-8	1 40	11 3-8
7-8	1 00	8	1 1-2	1 50	12
1	1 10	9			

RUBBER TIPPED FOUNDRY RAMMERS.



The Foundry Rammer, shown, has advantages over the rammer usually employed in foundries, in that it does not mar the pattern, whether it be of wood or metal and with it the mould can be made as hard as with the ordinary rammers.

The rubber tip is held in an iron holder by two pins and can be replaced, when worn, by a new tip at a small expense and with little trouble.

These rammers are made in two sizes.

The large size for general floor use, shown, is 3" wide, 7 3-8" long and holds a tip 3" wide, 11-16" thick and 3 4" high. It is provided with a wooden handle and an iron butt about 3" in diameter. The handles are furnished in two lengths, 47" or 58" over all.

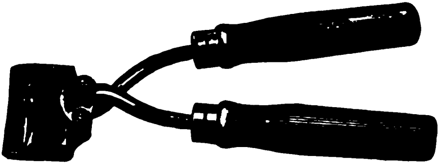
The small size is convenient for peening under large moulds and working in small spaces, as corners etc.

It is similar to the above, differing only in size and in the length of the ferrule. It is 2" wide, 2 3-4" long and holds a tip 2 3-16" wide, 11-16" thick and 3-4" high. It is provided with a handle made of 5-8" round iron, screwed into the holder, the length over all being 35 1-4".

Price, Large Rubber Tipped Foundry Rammers, complete, each, $0 85; Rubber Tips, each, $0 15; in lots of not less than one dozen, $1 50 per dozen.

Price, Small Rubber Tipped Foundry Rammers, complete, each, $0 70; Rubber Tips, each, $0 12; in lots of not less than one dozen, $1 20 per dozen.

IMPROVED HORSE CLIPPERS.



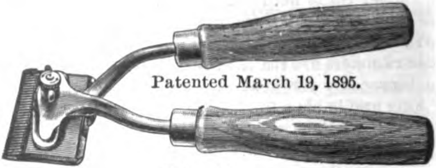
Price, $3 00.

Sent by Mail on Receipt of $3 25.

PRICES FOR SHARPENING AND REPAIRING.

Sharpening Clippers, ...	$0 60
New Top-Plate, including sharpening, ...	1 10
New Bottom-Plate, including sharpening, . . .	1 35

1895 DESIGN HORSE CLIPPERS.



Price, $2 25.

Sent by Mail on Receipt of $2 50.

PRICES FOR SHARPENING AND REPAIRING.

Sharpening Clippers, ...	$0 50
New Top-Plate, including sharpening, ...	0 75
New Bottom-Plate, including sharpening, . . .	1 00

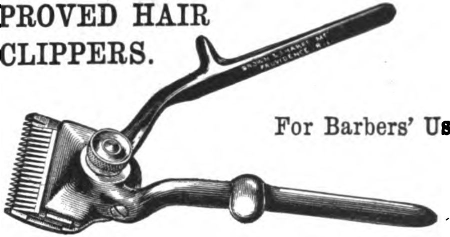
If other parts are needed, they are charged extra.

Parties wishing to have Clippers repaired can send them to us by mail at less expense than by express.

Our Clipper plates cannot be applied to other Clippers.

We cannot be responsible if the teeth break in sharpening. If Clippers are to be returned by mail, twenty-five cents should be remitted for postage.

IMPROVED HAIR CLIPPERS.



For Barbers' Use.

Number,	00	0	1	2	3
Price,	$3 00	$3 00	$3 00	$3 50	$4 00

Sent by mail on receipt of price and fifteen cents for postage.

1893 DESIGN HAIR CLIPPERS.

For Barbers' Use.

Patented August 23, 1892.

Number,	*000	*00	0	1	2	3
Price,	$3 00	$3 00	$3 00	$3 00	$3 50	$4 00

Sent by mail on receipt of price and fifteen cents for postage.
***This Clipper is not made in the new way; but is the same in design as in previous years, that design being satisfactory for so narrow a Clipper.**

PRICES FOR SHARPENING AND REPAIRING.

Sharpening Clippers, our own make,	$0 50
New Top Plate. including Sharpening,	1 00
Nos. 000 and 00 Bottom Plate, including Sharpening,	1 50
No. 0 Bottom Plate, including Sharpening,	1 50
No. 1 Bottom Plate, including Sharpening,	1 50
No. 2 Bottom Plate, including Sharpening,	1 75
No. 3 Bottom Plate, including Sharpening,	2 00
Sharpening Clippers, not our own make,	75

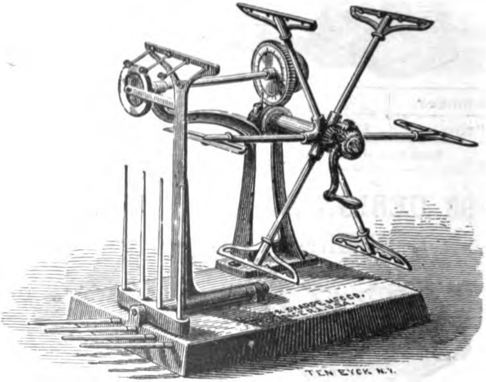
Our Hair Clipper Plates Cannot be Applied to Other Clippers.

If other parts are needed they are charged extra. We cannot be responsible if the teeth b... ...ening. If Clippers are to be returned by mail, fifteen cents sh... ...postage.

YARN REELS.

FOR USE IN CONNECTION WITH

Roving Scales and Yarn Testers, For Obtaining the Stretch, Strength and Number of Cotton, Woolen, and Worsted Yarns.



Price, $25 00.

The cut illustrates a Yarn Reel specially adapted for accurate reeling of fine yarns.

The reel is 54 inches, or one and a half yards, in circumference. The dial is graduated into 120 parts, indicating the number of yards reeled from each spindle. The yarn guides and spindles are kept in line with each other while feeding yarn upon the reel, which is very desirable when reeling fine yarns. The extra length of yarn guides is of use in increasing the friction upon the yarn by taking a half-turn or more of yarn around them. The *automatic feed motion* lays the yarn flat upon the reel, thus securing accurate and uniform measurement and consequently correct results as to stretch, strength and numbering. See our printed tables for use in connection with this reel, for numbering cotton, linen, woolen and worsted yarns.

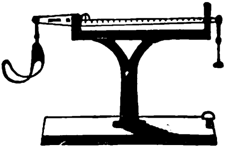
The bright spot on the web of the worm wheel is to show when the zero upon the dial approaches the index point, and thus assists the operator to stop promptly on the striking of the bell.

Made with four or seven spindles.

36 inch Reel carried in stock.

ROVING OR YARN SCALES.

OLD STYLE.



No. 912. Price, $8 00.

The beam is graduated into 100 parts, indicating grains.

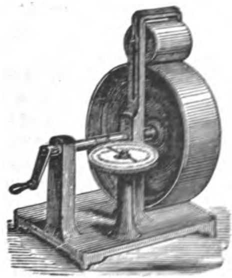
Four weights, 100, 200, 400 and 800 grains, are furnished with each scale.

A table showing the weights of all numbers of yarn in grains, a description of the scales and the uses to which it can be applied, is furnished with each.

ROVING REEL

To Accompany the Roving and Yarn Scales.

Price, $14 00.

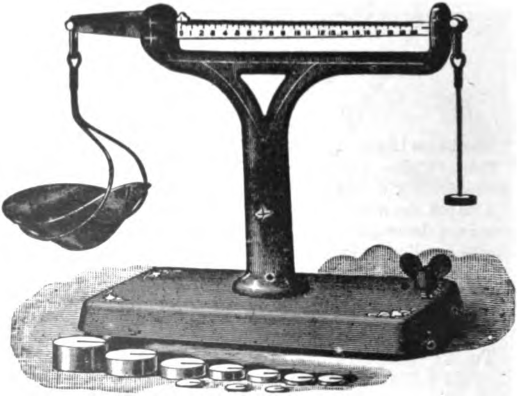


For reeling small quantities of roving, drawing and yarn and also to determine the number of twist in yarn.

Circumference of large drum 18".

IMPROVED ROVING OR YARN SCALES.

For Accurate Weighing.

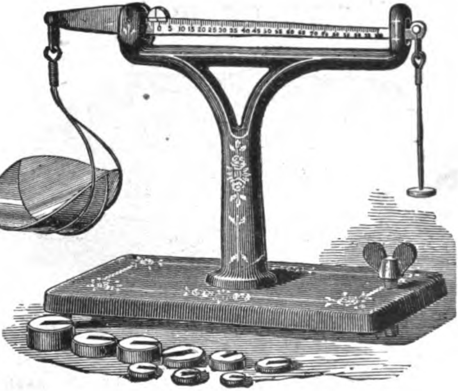


No. 910. **Price, $10 00.**

These scales will weigh one pound by tenths of grains or one seventy-thousandth part of one pound avoirdupois, rendering them especially well adapted for use in connection with Yarn Reels, for the numbering of yarn from the weight of hank, giving the weight in tenths of grains to compare with tables. They are also useful for the weighing of any small articles, colors, drugs etc., for computation of large quantities, or for postal scales. The finished parts are nickel-plated and the stand japanned and ornamented. Ten balancing weights accompany each scale, viz.: One each of 20, 30, 50, 100, 200, 300, 500, 1000, 2000 and 3000 grains; the 20 grains on the bear 'eing each divided into 10 parts.

One pound	avoirdupois	=	7000	grains.
1-2	" "	=	3500	"
1-4	" "	=	1750	"
1-8	" "	=	875	"
One ounce	"	=	437.5	"

SAMPLE WEIGHING SCALES.



No. 911. Price, $10 00.

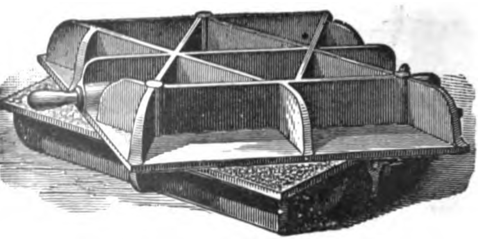
These scales will weigh one pound by ten thousandths of a pound. They are well adapted for weighing small articles, screws, samples of paper, color, drugs, &c., for the purpose of computing large quantities. They also answer as postal scales. The finished parts are all nickel-plated, and the stand is japanned and ornamented. Nine balancing weights accompany the scales, viz.: One each respectively of 100, 200, 400, 800, 1000, 2000, 2000, 4000 ten thousandths, and also one ounce weight for postage weighing.

7000 grains equal one pound avoirdupois.

One	ten	thousandth	of a	pound	equals	7-10 of a grain.	
156 1-4	"	"	"	"	"	1-4 of an ounce.	
312 1-2	"	"	"	"	"	1-2 "	"
468 3-4	"	"	"	"	"	3-4 "	"
625	"	"	"	"	"	1 "	"
2500	"	"	"	"	"	1-4 of a pound.	
5000	"	"	"	"	"	1-2 "	"
7500	"	"	"	"	"	3-4 "	"

We also make scales to weigh by the metric system to 1-100 gramme. Weights, 1, 2, 5, 10, 20, 40, 60, 100, 100, and 200 grammes.

STANDARD CAST IRON SURFACE PLATES.

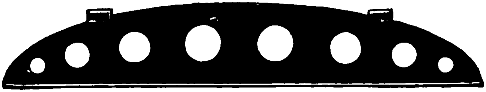


We have in stock a variety of sizes, to which we frequently make additions, all of which are uniform in style.

These plates are usually sold singly, not in pairs, as shown in cut. Unless otherwise specified, price is quoted for a single plate, with box and cover.

Size.	Weight.	Price Each.	Size.	Weight.	Price Each.
3½" x 4"	3 lbs.	$2 50	12" x 24"	100 lbs.	$35 00
3½ x 12	10	5 00	14 x 14	50	22 00
4 x 15	20	7 25	14 x 18	65	29 00
4½ x 6	5	3 25	14 x 21	95	35 00
5 x 16	25	9 50	15 x 30	160	54 00
6 x 6	10	4 25	16 x 16	65	29 00
6 x 12	20	8 50	16 x 48	380	99 00
6 x 26	50	17 00	18 x 18	80	37 00
6 x 50	120	37 00	18 x 24	130	50 00
6½ x 18	30	15 00	18 x 36	230	66 00
7 x 7½	10	6 25	20 x 30	215	72 00
7 x 10	15	8 00	22 x 80	1070	239 00
8 x 12	20	11 00	24 x 24	200	68 00
9 x 9	20	9 00	24 x 36	300	104 00
9 x 14	30	14 00	24 x 48	445	140 00
10 x 15	35	17 00	24 x 60	670	182 00
10 x 30	100	36 00	30 x 36	430	131 00
12 x 12	30	16 00	36 x 68	1025	300 00
12 x 18	55	25 00			

CAST IRON STRAIGHT EDGES.



These Straight Edges are of a form best adapted to retain a straight line.

The edge of each is scraped to form a true surface, and the straight edges when thus made are indispensable in the proper scraping of the ways of planer and lathe beds, etc.

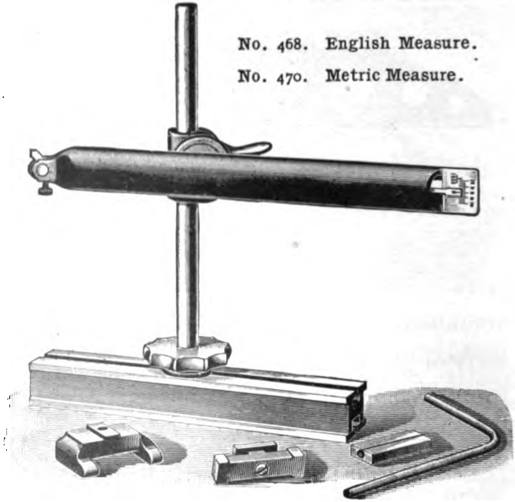
Size,	Price.	Weight.
*18″x 1 1-2″	$7 00	5 lbs.
*24 x 1 5-8	9 50	8 "
*30 x 1 3-4	12 00	13 "
*36 x 1 7-8	15 00	17 "
†48 x 2	20 50	35 "
†60 x 2 1-8	26 50	48 "
†72 x 2 1-4	33 00	72 "
†84 x 2 5-16	36 00	119 "
†96 x 2 3-8	39 00	145 "
†120 x 2 1-2	50 00	195 "
‡†180 x 3 1-2		832 "

* Price includes box with cover. † Price includes cover only.
‡ Made to order only. Price upon application.

TEST INDICATOR.

No. 468. English Measure.

No. 470. Metric Measure.



This Indicator is especially useful to those erecting or inspecting machines. It is possible by its use to readily determine the degree of inaccuracy of a plane surface on the top, bottom or side of a piece of work or to easily ascertain the amount of end movement, for example, of a spindle or the extent to which a spindle runs out of true.

The upright post, or stand, may be clamped at any point upon the base by the knurled nut. The sleeve which carries the arm may be fastened at any height on the post or turned around the post to bring the arm on either side. The arm turns in the sleeve and may be set at any angle relative to the base or may be inverted so that the point brought in contact with the work will be downward instead of the position shown.

The movement of this point is magnified a number of times by the length of the index finger or lever and its movements may be read upon the graduations shown.

The indexing finger may be adjusted and brought to zero by the knurl headed screw shown whatever may be the position of the arm.

A split block and angular post is furnished with the indicator.

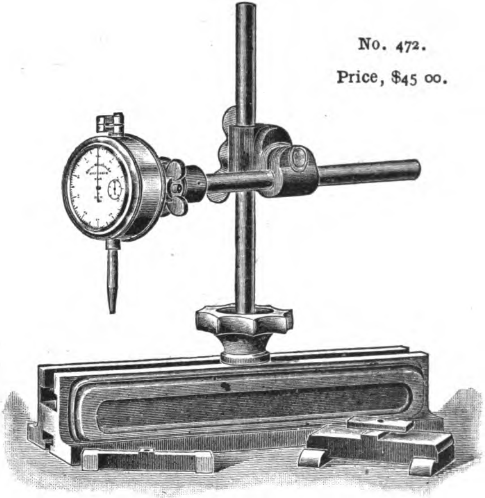
The length of the base is 8", the height of [illegible] the graduations read to thousandths of an [illegible] read to 1-50 m/m.

rice, $15 00.

DIAL TEST INDICATOR.

No. 472.

Price, $45 00.



This Indicator is especially serviceable to those erecting or inspecting machines, as it is possible to readily determine the degree of inaccuracy of a surface on the top, bottom or side of a piece of work, to ascertain the amount of end movement, for example, of a spindle, or the extent to which a spindle or arbor runs out of true.

The upright post or stand can be clamped at any point upon the base and the sleeve that carries the arm can be clamped at any height on the post or turned around the post to bring the arm on either side. The arm turns in the sleeve and can be set at any angle relative to the base or it can be removed from the post and used independently, as in the tool post of a lathe.

The movement of the point that bears against the work is magnified about 50 times and is indicated by the pointer on the dial, which is about 1 3-4" in diameter and plainly graduated to read to thousandths of an inch. The upper end of spindle is provided with jaws for measuring sheet metal etc. The spindle has a movement of 1-2".

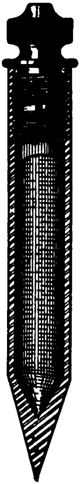
Stops are furnished for use on the under side of the base against perpendicular or angular surfaces.

The length of the base is 8" and the height of the post 9".

Each tool is neatly packed in a substantial box fitted for holding the various parts when not in use.

MERCURY PLUMB BOBS.

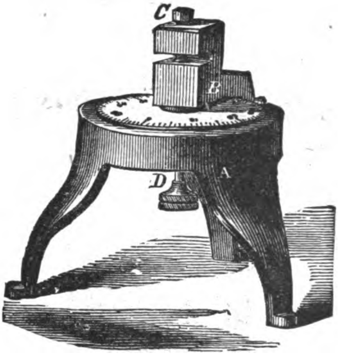
These Plumb Bobs are made of solid steel rod, bored out and filled with mercury, or quicksilver, which makes them unusually heavy, in proportion to their size, and the centre of gravity low. The cut at the left shows the manner in which these Plumb Bobs are constructed. The comparatively small diameters allow them to be used close to corners and walls, and are not easily affected by draughts of air, as well as allowing them to be carried or packed in small spaces.



The points are hardened, and the bodies and points are ground. The Plumb Bobs are nickel-plated, and each is furnished with a braided silk line. The 3½ oz. can easily be carried in the vest pocket.

No. 793,	3 1-2	oz.,	4″	long,	1-2″	diam.,	$1 00.
No. 794,	6	"	4 1-2	"	5-8	"	1 50.
No. 795,	12	"	5 3-8	"	7-8	"	2 00.
No. 796,	16	"	6	"	1	"	2 50.

SHEET METAL GAUGE.



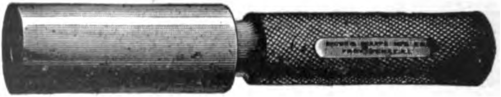
No. 742. Price, $10 00.

This Gauge will measure to 1-4″ by thousandths of an inch, and is found a convenient and substantial tool for Jewelers, Silversmiths, Sheet Metal Rollers and Workers, Rubber and Paper Manufacturers, Type Founders, etc.

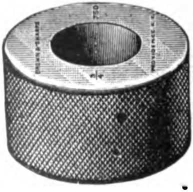
The frame A is of cast iron, japanned, and supports the measuring mechanism. The arm B is fastened to the frame and holds the measuring screw D and the adjusting screw C. The knurled thumb screw D is for operating the measuring screw and the movable dial. The movable dial is of German silver and the graduations are read by means of the pointer shown at the right of arm B. Provision is made for compensation for wear.

STANDARD INTERNAL AND EXTERNAL CYLINDRICAL GAUGES.

INTERNAL.



EXTERNAL.



These Standard Internal Cylindrical Gauges, or Plugs, and Standard External Cylindrical Gauges, or Rings, are made in the most careful manner, and furnish gauges for accurate measurements.

These Gauges are furnished singly, of any desired size, and also in regular sets containing sizes from one-quarter inch to two inches, inclusive, varying by sixteenths of an inch.

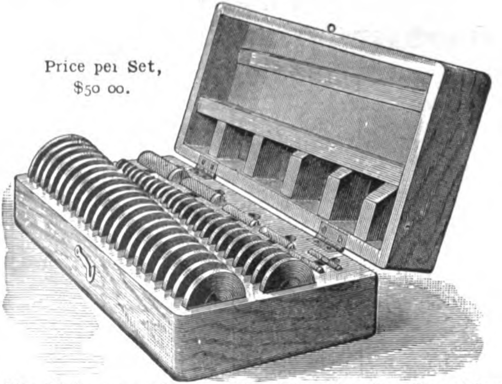
Metric Gauges are also carried in stock, in sizes from 6 m/m to 50 m/m, varying by 1 m/m; and from 55 m/m to 100 m/m, varying by 5 m/m.

Gauge Circular sent on application.
For Prices, see opposite page.

PRICES OF STANDARD INTERNAL AND EXTERNAL CYLINDRICAL GAUGES.

Sizes.	Internal.	External.	Both.
1-4″	$3 00	$4 45	$7 45
5-16	3 00	4 60	7 60
3-8	3 10	4 75	7 85
7-16	3 20	4 90	8 10
1-2	3 30	5 05	8 35
9-16	3 40	5 20	8 60
5-8	3 50	5 35	8 85
11-16	3 60	5 50	9 10
3-4	3 70	5 65	9 35
13-16	3 80	5 80	9 60
7-8	3 90	5 95	9 85
15-16	4 00	6 10	10 10
1	4 10	6 25	10 35
1 1-16	4 20	6 50	10 70
1 1-8	4 30	6 75	11 05
1 3-16	4 40	7 00	11 40
1 1-4	4 50	7 25	11 75
1 5-16	4 65	7 50	12 15
1 3-8	4 80	7 75	12 55
1 7-16	4 95	8 00	12 95
1 1-2	5 10	8 25	13 35
1 9-16	5 25	8 50	13 75
1 5-8	5 40	8 75	14 15
1 11-16	5 55	9 00	14 55
1 3-4	5 70	9 25	14 95
1 13-16	5 85	9 50	15 35
1 7-8	6 00	9 75	15 75
1 15-16	6 15	10 00	16 15
2	6 30	10 25	16 55
2 1-16	7 00	11 00	18 00
2 1-8	7 15	11 25	18 40
2 3-16	7 30	11 50	18 80
2 1-4	7 45	11 75	19 20
2 5-16	7 60	12 00	19 60
2 3-8	7 85	12 25	20 10
2 7-16	8 10	12 50	20 60
2 1-2	8 25	12 75	21 00
2 9-16	8 40	13 00	21 40
2 5-8	8 55	13 25	21 80
2 11-16	8 70	13 50	22 20
2 3-4	8 85	13 75	22 60
2 13-16	9 00	14 00	23 00
2 7-8	9 15	14 25	23 [illegible]
2 15-16	9 30	14 50	[illegible]
3	9 45	14 75	[illegible]

STANDARD REFERENCE DISKS.



The Disks are used, generally without handles, for setting calipers, testing measuring tools, and reference for sizes in shop practice.

With handles, they are used in place of Standard Cylindrical Gauges, but are not recommended for constant use as substitutes for these.

These Disks are of steel, hardened, and accurately ground. A complete set consists of 45 disks, varying by 16ths of an inch, from 1-4" to 3" diameter, and six handles.

Size.	Price.	Size.	Price	Size.	Price.	Size.	Price.
*1-4"	$1 50	1"	$1 10	1 11-16"	$1 40	2 7-16"	$1 80
*5-16	1 50	1 1-16	1 10	1 3-4	1 40	2 1-2	1 80
3-8	90	1 1-8	1 10	1 13-16	1 55	2 9-16	1 95
7-16	90	1 3-16	1 10	1 7-8	1 55	2 5-8	1 95
1-2	1 00	1 1-4	1 10	1 15-16	1 55	2 11-16	1 95
9-16	1 00	1 5-16	1 25	2	1 55	2 3-4	2 10
5-8	1 00	1 3-8	1 25	2 1-16	1 65	2 13-16	2 10
11-16	1 00	1 7-16	1 25	2 1-8	1 65	2 7-8	2 25
3-4	1 05	1 1-2	1 25	2 3-16	1 65	2 15-16	2 25
13-16	1 05	1 9-16	1 40	2 1-4	1 65	3	2 25
7-8	1 05	1 5-8	1 40	2 5-16	1 80		
15-16	1 05			2 3-8	1 80		

PRICES OF HANDLES.

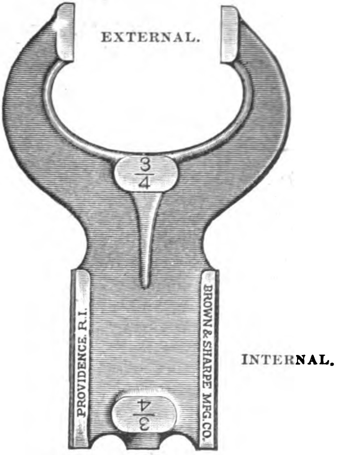
For 3-8" to 9-16" Disks,	$0 65	For 1 1-8" to 1 3-4" Disks,	$0 80
For 5-8" to 1 1-16" Disks,	75	For 1 13-16" to 3" Disks,	90

Metric Gauges are also carried in stock, in sizes from 6 m/m to 50 m/m, varying by 2 m/m; and 55 m/m to 100 m/m, varying by 5 m/m.

Special Sizes made to order.

Sizes marked * are furnished with Handles.

STANDARD CALIPER GAUGES.



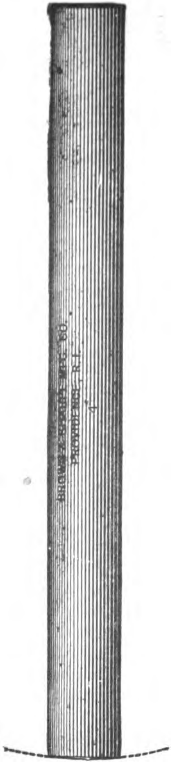
These Gauges are hardened and ground accurately, one end for outside and the other for inside measurement. By their use, mistakes in the setting of calipers and variations in measurements by different workmen, will be in a great measure avoided. Their form gives lightness and strength, making them preferable to plugs and rings for frequent use. As furnishing convenient and reliable standard sizes for every day use in the workshop, they are of great advantage and their use will contribute to uniformity in the production of the working parts of machinery.

These Gauges are furnished separately of any desired size to three inches. Sizes larger than three inches are made in two parts for convenience in handling. They are also supplied in sets; each full set, neatly arranged in a box, contains sizes from one-quarter inch to two and one-half inches diameter, varying by sixteenths of an inch up to two inches diameter and above that by eighths of an inch.

STANDARD
END MEASURING RODS.

WITH SPHERICAL ENDS.

English or Metric Measure.



The Standard End Measuring Rods are made of steel, hardened on the ends and accurately ground, so that the ends are sections of true spheres having diameters equal to those of the length of the rods. These Rods can be used for measuring rings, cylinders etc., setting callipers, comparing gauges or other work of like character and are especially useful for measuring parallel surfaces, as the Spherical Ends will pass by such surfaces without cramping, as would spheres of like diameters.

We furnish them in all lengths from 3″ to 16″, inclusive. The Rods from 3″ to 6″ are 3-8″ in diameter and larger than 6″, 1-2″ in diameter.

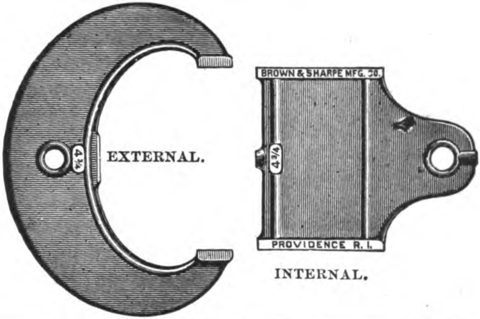
PRICE LIST.

Length.	Price.	Length.	Price.
3″	$1 40	10″	$2 80
4	1 60	11	3 00
5	1 80	12	3 20
6	2 00	13	3 40
7	2 20	14	3 60
8	2 40	15	3 80
9	2 60	16	4 00

All intermediate sizes furnished at the price of the size next larger given in the list.

Metric Sizes. Prices upon application.

STANDARD CALIPER GAUGES.



EXTERNAL.

INTERNAL.

Size.	Prices. Both Ends Fnshd.	Prices. Single End Fnshd.	Size.	Prices. Both Ends Fnshd.	Prices. Single End Fnshd.	Size.	Prices. Both Ends Fnshd.	Prices. Single End Fnshd
1-4″	$2 50	$1 40	1 3-16″	$2 85	$1 55	2 1-8″	$4 00	$2 20
5-16	2 50	1 40	1 1-4	2 90	1 60	2 3-16	4 10	2 30
3-8	2 50	1 40	1 5-16	2 95	1 60	2 1-4	4 20	2 30
7-16	2 50	1 40	1 3-8	3 00	1 65	2 5-16	4 30	2 30
1-2	2 50	1 40	1 7-16	3 05	1 65	2 3-8	4 40	2 40
9-16	2 50	1 40	1 1-2	3 10	1 70	2 7-16	4 50	2 40
5-8	2 50	1 40	1 9-16	3 20	1 75	2 1-2	4 60	2 50
11-16	2 50	1 40	1 5-8	3 30	1 80	2 9-16	5 00	2 80
3-4	2 50	1 45	1 11-16	3 40	1 90	2 5-8	5 25	2 90
13-16	2 55	1 45	1 3-4	3 50	2 00	2 11-16 to 2 3-4	5 50	3 00
7-8	2 60	1 45	1 13-16	3 60	2 00			
15-16	2 65	1 45	1 7-8	3 70	2 10	2 13-16 to 2 15-16	6 00	3 30
1	2 70	1 50	1 15-16	3 80	2 10			
1 1-16	2 75	1 50	2	3 90	2 20	3	6 50	
1 1-8	2 80	1 55	2 1-16	3 95	2 20			

THE FOLLOWING SIZES ARE MADE IN TWO PARTS.

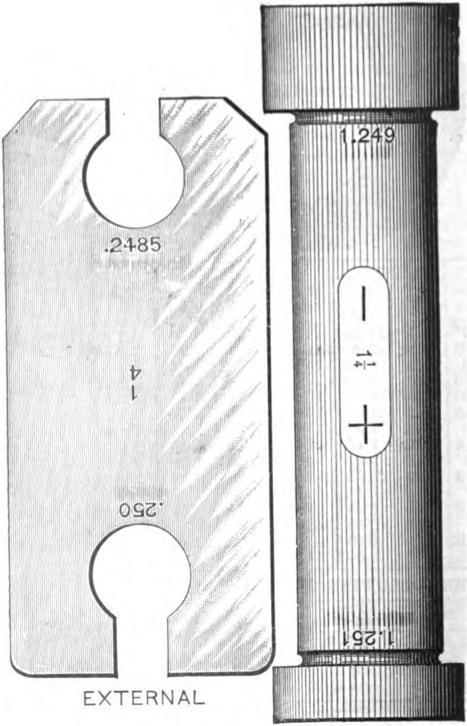
Size.	Price, Both Parts.	Price, One Part	Size.	Price, Both Parts.	Price, One Part.
3″ to 3 1-4″	$6 50	$3 25	4 1-16″ to 5″	$8 50	$4 25
3 5-16 to 3 1-2	7 00	3 50	5 1-16 to 6	9 00	4 50
3 9-16 to 3 3-4	7 50	3 75	6 1-16 to 7	9 50	4 75
3 13-16 to 4	8 00	4 00	7 1-16 to 8	10 00	5 00

EXTERNAL END ONLY.

8 1-16″ to 9″, .	Price, $5 65	10 1-16″ to 11″,	Price, $7 00
9 1-16 to 10, .	Price, 6 25	11 1-16 to 12,	Price, 8 00

Metric Gauges are also carried in stock, in sizes from 5 m/m to 100 m/m, varying by 1 m/m; 6 m/m to 50 m/m, varying by 2 m/m; and 105 m/m to 150 m/m, varying by 5 m/m. **Prices furnished on application.**

LIMIT GAUGES.



EXTERNAL

INTERNAL

LIMIT GAUGES.

The accurate production of duplicate parts, as required in the economical manufacture of machinery, tools, instruments etc. demands accurate Gauges and, in order to secure the most economical production, Limit Gauges are necessary to avoid time being wasted in finishing the work unduly accurate and still leaving it so that two or more parts when brought together will fit sufficiently well to meet requirements.

The advantages derived from the use of Limit Gauges are being appreciated more and more, as, by their use, the time consumed in testing and gauging is reduced to a mini mum, and the duplication of parts is insured.

Our facilities in the Gauge department enable us to furnish Gauges of any required form or degree of accuracy.

We are pleased to give the benefit of our extended experience in the use of these Gauges connected with the manufacture of machinery and tools and to assist in selecting the Gauges best suited for any special work.

The cuts shown on opposite page represent the most common form of Internal and External Limit Gauges, such as we have found well adapted for our work.

The two ends of Gauges of this type are of different shape. The workman is thus enabled to easily and quickly distinquish the large from the small end without looking at the sizes stamped upon the Gauge.

These Gauges are not only used as references for finishing operations but are of great advantage in roughing work for finishing. When used in this way the same amount of stock is left on each piece, thus enabling the operator, who finishes the pieces, to work to better advantage than if they were of various sizes.

Prices are quoted on Limit or Special Gauges of all descriptions when specifications, drawings or samples of work are sent.

The degree of accuracy required should be plainly stated in thousandths or fractions of a thousandth of an inch.

GROUND FLAT STOCK.

This Stock is of service not only in tool work for making flat gauges, test tools, "jig work," etc., but in all work requiring steel of a definite thickness.

This steel is of first quality, cut the length of the sheet, annealed, and ground to within a limit of .001" of the given thickness.

PRICES.

Size in Inches.	Price per Pound.	Size in Inches.	Price per Pound.
1-16		**3-16**	
2 x 18 x 1-16	$0 80	2 x 18 x 3-16	$0 45
2 1-2 x 18 x 1-16	0 80	2 1-2 x 18 x 3-16	0 45
3 x 18 x 1-16	0 80	3 x 18 x 3-16	0 45
3 1-2 x 18 x 1-16	0 80	3 1-2 x 18 x 3-16	0 45
4 x 18 x 1-16	0 80	4 x 18 x 3-16	0 45
3-32		**7-32**	
2 x 18 x 3-32	0 65	2 x 18 x 7-32	0 45
2 1-2 x 18 x 3-32	0 65	2 1-2 x 18 x 7-32	0 45
3 x 18 x 3-32	0 65	3 x 18 x 7-32	0 45
3 1-2 x 18 x 3-32	0 65	3 1-2 x 18 x 7-32	0 45
4 x 18 x 3-32	0 65	4 x 18 x 7-32	0 45
1-8		**1-4**	
2 x 18 x 1-8	0 50	2 x 18 x 1-4	0 40
2 1-2 x 18 x 1-8	0 50	2 1-2 x 18 x 1-4	0 40
3 x 18 x 1-8	0 50	3 x 18 x 1-4	0 40
3 1-2 x 18 x 1-8	0 50	3 1-2 x 18 x 1-4	0 40
4 x 18 x 1-8	0 50	4 x 18 x 1-4	0 40
5-32			
2 x 18 x 5-32	0 50		
2 1-2 x 18 x 5-32	0 50		
3 x 18 x 5-32	0 50		
3 1-2 x 18 x 5-32	0 50		
4 x 18 x 5-32	0 50		

Other sizes furnished to order. Prices upon application.

MICROMETER CALIPERS.

Micrometer calipers form convenient and accurate instruments for fine external measurements. They are made in different sizes and styles to measure all sizes to twenty-four inches. They are graduated to read to thousandths of an inch, but one-half and one-quarter thousandths are readily estimated. Some of the calipers have verniers by which sizes can be obtained to ten-thousandths. We also furnish some of these instruments to read to hundredths of a millimetre instead of to thousandths of an inch.

The gauge screws, except in Calipers Nos. 1 and 71, are encased and protected from dirt and liability to injury. The parts most subject to wear are hardened and means of adjustment are provided to compensate for wear of the screw or nut. The decimal equivalents stamped on the frame are very convenient and render possible the immediate expression of readings in eighths, sixteenths, thirty-seconds and sixty-fourths of an inch. When graduated to read to hundredths of a millimetre, the tables of decimal equivalents are omitted.

The chief mechanical principle embodied in the construction is that of a screw free to move in a fixed nut. An opening, to receive the work to be measured, is afforded by the backward movement of the screw and the size of the opening is indicated by the graduations.

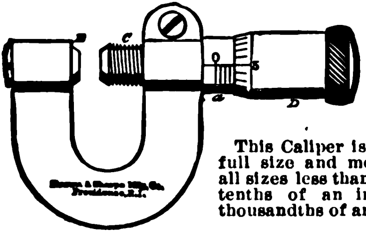
The pitch of the screw *c*, is forty to the inch. The graduation of the hub, *a*, in a line parallel to the axis of the screw, is forty to the inch and is figured 0, 1, 2, etc., every fourth division. As the graduation conforms to the pitch of the screw; each division equals the longitudinal distance traversed by the screw in one complete rotation and shows that the caliper has been opened one-fortieth or .025 of an inch. The beveled edge of the thimble, D, is graduated into twenty-five parts and figured every fifth division, 0, 5, 10, 15, 20. Each division, when passing the line of graduations on the hub, indicates that the screw has made one twenty-fifth of a turn and the opening of the caliper increased one twenty-fifth of one-fortieth, or one thousandth of an inch.

Hence, to read the caliper, multiply the number of divisions visible on the scale of the hub by twenty-five and add the number of divisions on the scale of the thimble from zero to the line coincident with the line of graduations on hub.

MICROMETER CALIPER No. 1.

(Pocket Sheet Metal Gauge.)

Price, $4 00. In Morocco Case, $4 50.

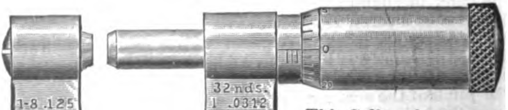


This Caliper is shown full size and measures all sizes less than three-tenths of an inch by thousandths of an inch.

MICROMETER CALIPER No. 2.

English or Metric Measure.

Price, $4 50. With Ratchet Stop, $5 00.
Morocco Case, $0 50.



This Caliper is shown full size and measures all sizes less than one-half inch by 1000ths of an inch. This Caliper is also made to measure all sizes less than 13 millimetres by 100ths of a millimetre. When so made the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 3.

Price, $5 50. With Ratchet Stop, $6 00.
Morocco Case, $0 50.

This Caliper differs from Micrometer Caliper No. 2, English, only in being graduated to read to ten-thousandths, as well as thousandths of an inch.

RATCHET STOP
FOR MICROMETER CALIPERS.

Patented November 6, 1894.

For Micrometer Calipers with Ratchet Stop add 50 cents to the regular price.

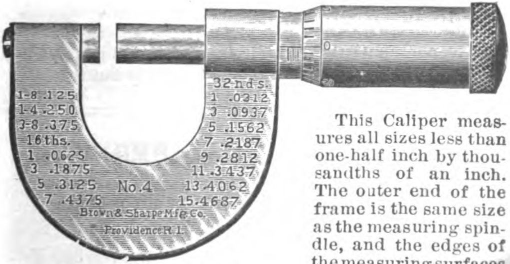
The Ratchet Stop can be furnished with any of our Micrometer Calipers. It is found convenient where a number of measurements have to be quickly taken, as it enables the objects measured to be subjected to the same degree of pressure.

In opening the tool, the pawl positively engages the ratchet so that it cannot slip by, thus making the Ratchet Stop positive in its return.

The ratchet and pawl are hardened.

MICROMETER CALIPER No. 4.
English or Metric Measure.

Price, $4 50. With Ratchet Stop $5 00.
Morocco Case, $0 50.



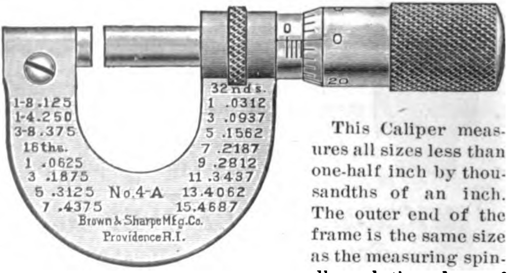
This Caliper measures all sizes less than one-half inch by thousandths of an inch. The outer end of the frame is the same size as the measuring spindle, and the edges of the measuring surfaces are not beveled but are left square. This Caliper is also made to measure all sizes less than thirteen millimetres by hundredths of a millimetre. When so made the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 4-A.

English or Metric Measure.

Price, $4 50. With Ratchet Stop, $5 00.
Morocco Case, $0 50.

Patented December 30, 1902.



This Caliper measures all sizes less than one-half inch by thousandths of an inch. The outer end of the frame is the same size as the measuring spindle and the edges of the measuring surfaces are left square. Each Caliper is provided with a clamp ring which clamps the spindle and preserves the setting.

This Caliper is also made to measure all sizes less than thirteen millimetres by hundredths of a millimetre. When so made the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 5.

Price, $5 50. With Ratchet Stop, $6 00.
Morocco Case, $0 50.

This Caliper differs from Micrometer Caliper No. 4, English, only in being graduated to read to ten thousandths, as well as thousandths of an inch.

MICROMETER CALIPER No. 5-A.

Price, $5 50. With Ratchet Stop, $6 00.
Morocco Case, $0 50.

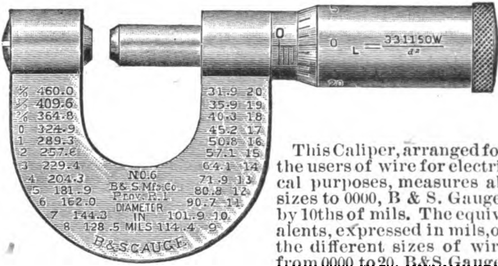
Patented December 30, 1902.

This Caliper differs from Micrometer Caliper No. 5 only in having a clamp ring which clamps the spindle and preserves the setting.

MICROMETER CALIPER No. 6.

For Electricians.

Price, $5 50. With Ratchet Stop, $6 00.
Morocco Case, $0 50.



This Caliper, arranged for the users of wire for electrical purposes, measures all sizes to 0000, B & S. Gauge, by 10ths of mils. The equivalents, expressed in mils, of the different sizes of wire from 0000 to 20, B&S. Gauge, are stamped on one side of the frame and the circular mils of the same size on the other.

Three formulas are stamped on the thimble: one for the weight, length in feet and diameter being known; one for length in feet, weight and diameter being known; and one for resistance of commercial copper wire, in ohms per hundred feet at 75° F., length and diameter being known.

MICROMETER CALIPER No. 7.

For Electricians.

Price, $5 50. With Ratchet Stop, $6 00.
Morocco Case, $0 50.

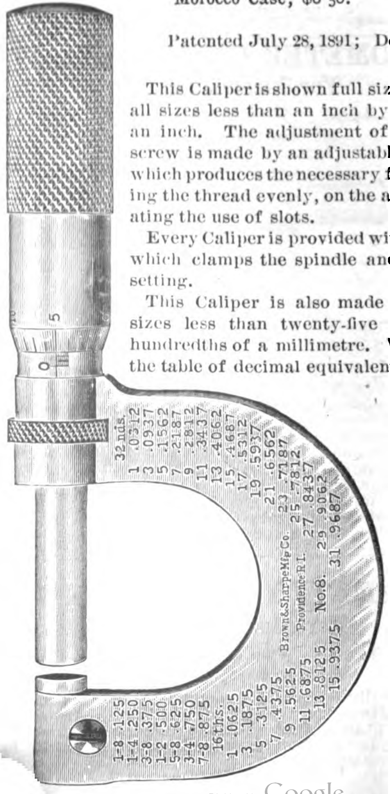
This Caliper differs from Micrometer Caliper No. 6, only in that the equivalents stamped on one side of the frame are for wire from 21 to 44, B. & S. Ga[illegible] the resistance of commercial copper wire, in o[illegible] feet at 75° F., of the same sizes on the othe[illegible]

MICROMETER CALIPER No. 8.

English or Metric Measure.

Price, $5 50. With Ratchet Stop, $6 00.

Morocco Case, $0 50.



Patented July 28, 1891; Dec. 30, 1902.

This Caliper is shown full size and measures all sizes less than an inch by thousandths of an inch. The adjustment of the measuring screw is made by an adjustable threaded nut which produces the necessary friction by binding the thread evenly, on the angle, thus obviating the use of slots.

Every Caliper is provided with a clamp ring which clamps the spindle and preserves the setting.

This Caliper is also made to measure all sizes less than twenty-five millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 10.

Price, $6 50. With Ratchet Stop, $7 00.

Morocco Case, $0 50.

Patented July 28, 1891, and December 30, 1902.

This Caliper differs from Micrometer Caliper No. 8, only in being graduated to read to *ten-thousandths* of an inch by a Vernier on the front of the barrel.

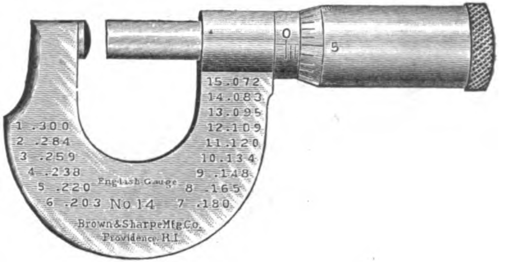
Every Caliper is provided with a clamp ring which clamps the spindle and preserves the setting.

MICROMETER CALIPER No. 14.

For Measuring the Thickness of Tubing.

Price, $4 50. With Ratchet Stop, $5 00.

Morocco Case, $0 50.



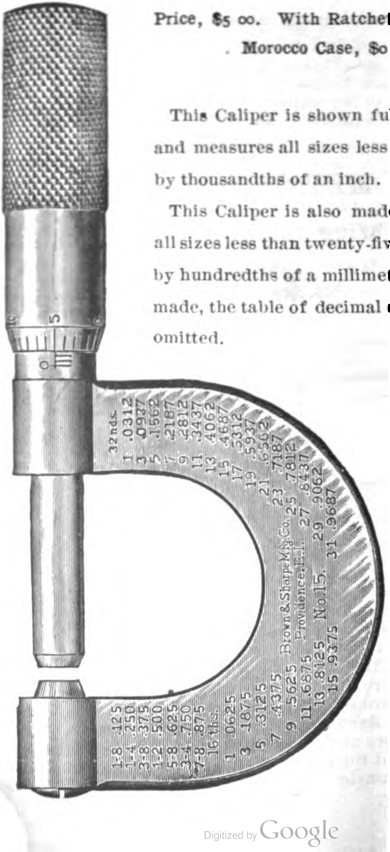
This Caliper, shown full size, is designed especially to meet the demand for an instrument to *measure accurately* the thickness of tubing and is well adapted for use in Tube Works, Boiler Shops, Bicycle Manufactories etc.

It will measure the thickness of tubing from 5-16″ inside diameter upward by 1-1000 of an inch.

The anvil, or fixed measuring point, is *rounded* on the end so that it touches at only one point on the inside of the tube and, the end of the movable spindle being flat, touches at only one point on the outside, thus giving the exact thickness of the tube.

MICROMETER CALIPER No. 15.

English or Metric Measure.



Price, $5 00. With Ratchet Stop, $5 50.
Morocco Case, $0 50.

This Caliper is shown full size in cut, and measures all sizes less than an inch by thousandths of an inch.

This Caliper is also made to measure all sizes less than twenty-five millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 16.

Price, $6 00. With Ratchet Stop, $6 50.

Morocco Case, $0 50.

This Caliper differs from Micrometer Caliper No. 15, English, only in being graduated to read to ten-thousandths as well as thousandths of an inch.

MICROMETER CALIPER No. 17.

English or Metric Measure.

Price, $5 50. With Ratchet Stop, $6 00.

Morocco Case, $0 50.

This Caliper differs from Micrometer Caliper No. 15, only in having a Clamp Screw which clamps the spindle and preserves the setting.

Wooden Handle. This Caliper is furnished, when desired, with a wooden handle attached to the bow. The handle is about 2 3-4″ long. The Clamp Screw is provided with wings instead of a knurled head. **Price, $1 50,** in addition to prices given above.

MICROMETER CALIPER No. 18.

Price, $6 50. With Ratchet Stop, $7 00.

Morocco Case, $0 50.

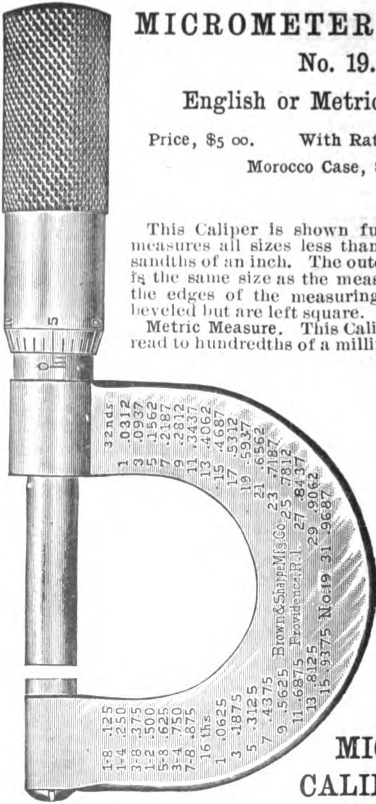
This Caliper differs from Micrometer Caliper No. 17, English, only in being graduated to read to ten-thousandths as well as thousandths of an inch.

SOFT LEATHER

CASES FOR MICROMETER CALIPERS.

Price, ... 15 Cents.

These cases are convenient for those who wish to carry a Micrometer Caliper in the pocket.



MICROMETER CALIPER

No. 19.

English or Metric Measure.

Price, $5 00. With Ratchet Stop, $5 50.
Morocco Case, $0 50.

This Caliper is shown full size in cut and measures all sizes less than an inch by thousandths of an inch. The outer end of the frame is the same size as the measuring spindle, and the edges of the measuring surfaces are not beveled but are left square.

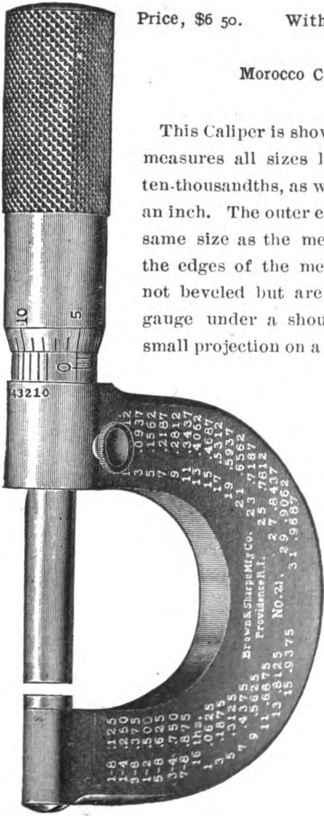
Metric Measure. This Caliper is also made to read to hundredths of a millimetre.

MICROMETER CALIPER No. 20.

Price, $6 00. With Ratchet Stop. $6 50.
Morocco Case, $0 50.

This Caliper differs from Micrometer Caliper No. 19, English, only in being graduated to read to ten-thousandths, as well as to thousandths of an inch.

MICROMETER CALIPER No. 21.



Price, $6 50. With Ratchet Stop, $7 00.

Morocco Case, $0 50.

This Caliper is shown full size in cut and measures all sizes less than an inch by ten-thousandths, as well as thousandths of an inch. The outer end of the frame is the same size as the measuring spindle, and the edges of the measuring surfaces are not beveled but are left square. It will gauge under a shoulder, or measure a small projection on a plain surface.

A Clamp Screw is provided by which the measuring spindle can be held in any desired position.

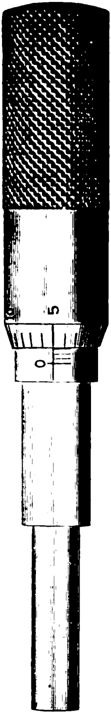
This Caliper is also made to measure all sizes less than twenty-five millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 22.

English or Metric Measure.

Price, $5 50. With Ratchet Stop, $6 00.

Morocco Case, $0 50.



This Caliper differs from Micrometer Caliper No. 19, only in having a Clamp Screw, which clamps the spindle and preserves the setting.

---

1 Inch
MICROMETER HEADS.

English or Metric Measure.

Graduated to read to thousandths of an inch.

Price, $3 50.
With Ratchet Stop, $4 00.

Graduated to read to thousandths and ten-thousandths of an inch.

Price, $4 50.
With Ratchet Stop, $5 00.

These Micrometer Heads are readily attached to machines or tools, when fine adjustments are required.

Length, from lower end of barrel to shoulder, 3-4″; diameter, 3-8″.

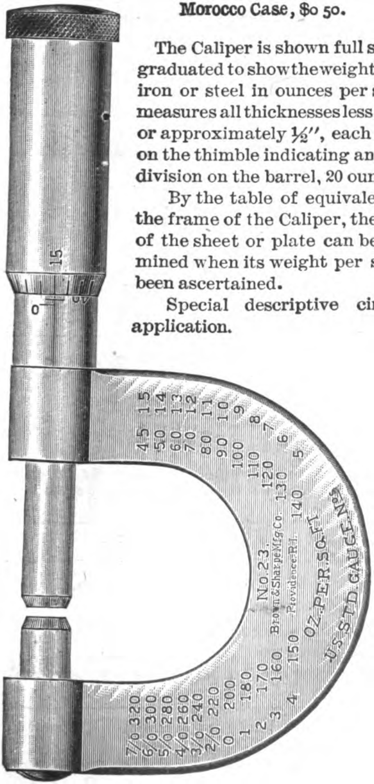
Metric Measure. This head is also furnished to read to hundredths of a millimetre.

MICROMETER CALIPER No. 23.

U. S. STANDARD GAUGE FOR SHEET AND PLATE IRON AND STEEL.

Price, $5 00. With Ratchet Stop, $5 50.

Morocco Case, $0 50.



The Caliper is shown full size in cut, and is graduated to show the weight of sheet or plate iron or steel in ounces per square foot. It measures all thicknesses less than 0000000, or approximately ½″, each of the divisions on the thimble indicating an ounce and each division on the barrel, 20 ounces.

By the table of equivalents stamped on the frame of the Caliper, the gauge number of the sheet or plate can be quickly determined when its weight per square foot has been ascertained.

Special descriptive circular sent on application.

MICROMETER CALIPER No. 30.

English or Metric Measure.

Price, $8 00. With Ratchet Stop, $8 50.
Morocco Case, $0 75.

Patented August 16, 1887.

This Caliper measures all sizes less than two inches by thousandths of an inch. The edges of the measuring surfaces are not beveled but left square.

This Caliper is also made to measure all sizes less than fifty millimetres by hundredths of a millimetre. When so made the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 31.

English or Metric Measure.

Price, $8 50. With Ratchet Stop, $9 00.
Morocco Case, $0 75.

Patented August 16, 1887.

This Caliper differs from Micrometer Caliper No. 30, only in having a Clamp Screw which clamps the spindle and preserves the setting.

MICROMETER CALIPER No. 32.

Price, $9 00. With Ratchet Stop, $9 50.
Morocco Case, $0 75.

Patented August 16, 1887.

This Caliper differs from Micrometer Caliper No. 30, only in being graduated to read to ten-thousandths as well as thousandths of an inch.

MICROMETER CALIPER No. 33.

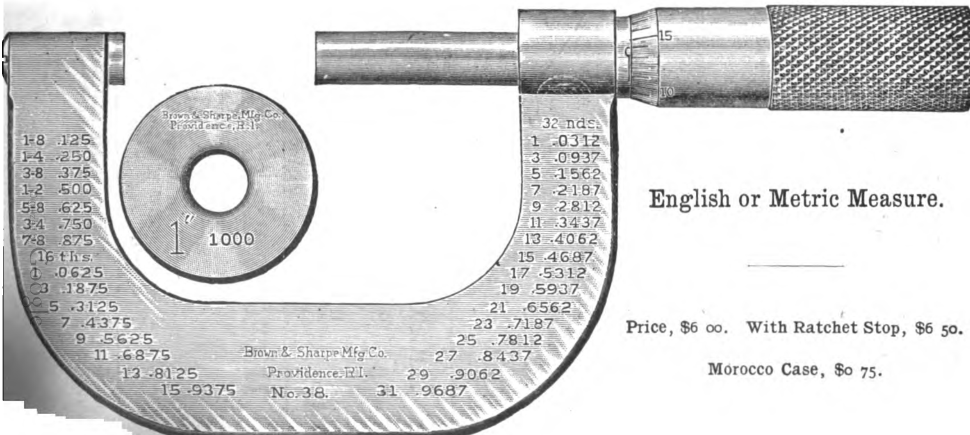
Price, $9 50. With Ratchet Stop, $10 00.
Morocco Case, $0 75.

Patented August 16, 1887.

This Caliper differs from Micrometer Caliper No. 32, only in having a Clamp Screw which clamps the spindle and preserves the setting.

A Standard Gauge, to be used in adjusting the Caliper, is sent with each one of the above.

MICROMETER CALIPER No. 38.



English or Metric Measure.

Price, $6 00. With Ratchet Stop, $6 50.

Morocco Case, $0 75.

MICROMETER CALIPER No. 38.

English or Metric Measure.

Price, $6 00. With Ratchet Stop, $6 50.
Morocco Case, $0 75.

This Caliper is shown nearly full size and measures all sizes above one inch and less than two inches by thousandths of an inch.

The outer end of the frame is the same size as the measuring spindle and the edges of the measuring surfaces are not beveled but are left square. It gauges under a shoulder or measures a small projection on a plain surface.

This Caliper is also made to measure all sizes between twenty-five and fifty millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 39.

English or Metric Measure.

Price, $6 50. With Ratchet Stop, $7 00.
Morocco Case, $0 75.

This Caliper differs from Micrometer Caliper No. 38, only in having a Clamp Screw which clamps the spindle and preserves the setting.

MICROMETER CALIPER No. 40.

Price, $7 00. With Ratchet Stop, $7 50.
Morocco Case, $0 75.

This Caliper differs from Micrometer Caliper No. 38, English measure, only in being graduated to read to ten-thousandths as well as thousandths of an inch.

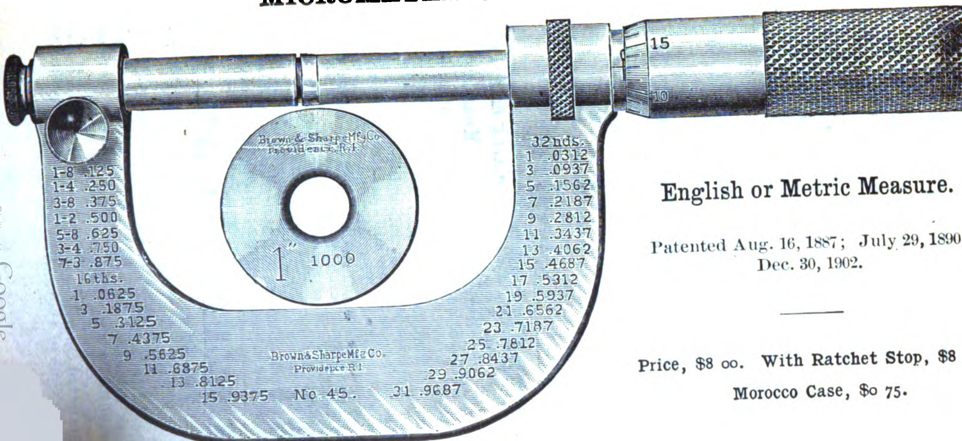
MICROMETER CALIPER No. 41.

Price, $7 50. With Ratchet Stop, $8 00.
Morocco Case, $0 75.

This Caliper differs from Micrometer Caliper No. 40, only in having a Clamp Screw which clamps the spindle and preserves the setting.

A Standard Gauge, to be used in adjusting the Caliper, is sent with each one of the above.

MICROMETER CALIPER No. 45.



English or Metric Measure.

Patented Aug. 16, 1887; July 29, 1890; Dec. 30, 1902.

Price, $8 oo. With Ratchet Stop, $8 50.

Morocco Case, $0 75.

MICROMETER CALIPER No. 45.

English or Metric Measure.

Price, $8 00. With Ratchet Stop, $8 50.
Morocco Case, $0 75.

Patented Aug. 16, 1887; July 29, 1890; Dec. 30, 1902.

This Caliper is shown nearly full size and measures all sizes less than two inches by thousandths of an inch. It is similar in general design to the Nos. 8 and 10. This Caliper is also made to measure all sizes less than fifty millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

Every Caliper is provided with a clamp ring which clamps the spindle and preserves the setting.

MICROMETER CALIPER No. 46.

Price, $9 00. With Ratchet Stop, $9 50.
Morocco Case, $0 75.

Patented Aug. 16, 1887; July 29, 1890; Dec. 30, 1902.

This Caliper differs from Micrometer Caliper No. 45, English measure, only in being graduated to read to ten-thousandths as well as thousandths of an inch.

MICROMETER CALIPER No. 47.

English or Metric Measure.

Price, $6 00. With Ratchet Stop, $6 50.
Morocco Case, $0 75.

Patented July 29, 1890; Dec. 30, 1902.

This Caliper, similar in general design to No. 8, measures all sizes above one inch and less than two inches, by thousandths of an inch. The outer end of the frame is the same size as the measuring spindle and the edges of the measuring surfaces are left square.

Every Caliper is provided with a clamp ring which clamps the spindle and preserves the setting.

This Caliper is also made to measure all sizes above 25 and less than 50 millimetres by hundredths of a millimetre. When so made, the table of decimal equivalents is omitted.

MICROMETER CALIPER No. 48.

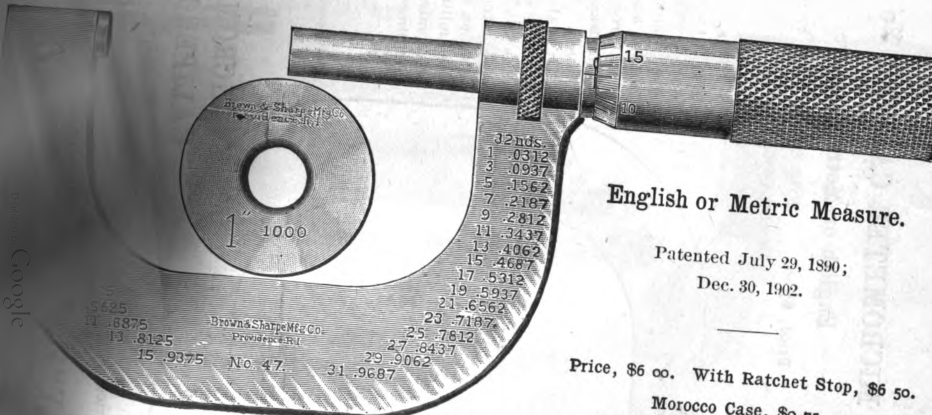
Price, $7 00. With Ratchet Stop, $7 50.
Morocco Case, $0 75.

Patented July 29, 1890; Dec. 30, 1902.

This Caliper differs from Micrometer Caliper [illegible] English measure, only in being graduated to re[illegible] thousandths as well as thousandths of an inch.

A Standard Gauge, to be used in adjusting t[illegible] sent with each of the above.

MICROMETER CALIPER No. 47.

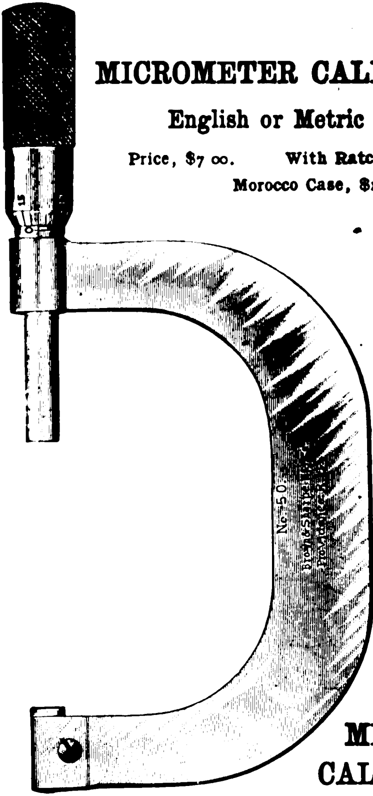


English or Metric Measure.

Patented July 29, 1890;
Dec. 30, 1902.

Price, $6 oo. With Ratchet Stop, $6 5o.

Morocco Case, $o 75.



MICROMETER CALIPER No. 50

English or Metric Measure.

Price, $7 00. With Ratchet Stop, $7 50.
Morocco Case, $1 00.

This Caliper, shown two-thirds size, measures all sizes above two inches and less than three inches by thousandths of an inch.

It is also made to measure all sizes above fifty millimetres and less than seventy-five millimetres by hundredths of a millimetre.

MICROMETER CALIPER No. 52.

English or Metric Measure.

Price, $7 50. With Ratchet Stop, $8 00. Morocco Case, $1 00.

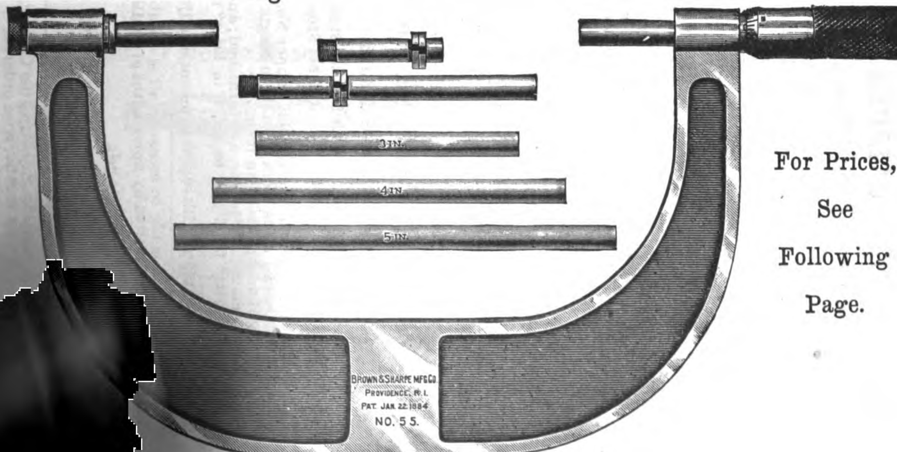
Patented July 29, 1890; Dec. 30, 1902.

This Caliper differs from Micrometer Caliper No. 50, only in having a clamp ring by which the measuring spindle can be held in any desired position.

A Standard Gauge, to be used in adjusting the Calipers, is furnished with each of the above.

MICROMETER CALIPER No. 55.

English or Metric Measure.



For Prices,
See
Following
Page.

MICROMETER CALIPER No. 55.

English or Metric Measure.

Price, with Standards, $14 00. With Ratchet Stop, $14 50.
Price, without Standards, $10 00. With Ratchet Stop, $10 50.

This Micrometer Caliper is shown about one-half size.
It measures all sizes from 3" to 6" in length and 6" in diameter by thousandths of an inch, but one-half and one-quarter thousandths are easily estimated.
Three anvils are furnished; the long anvil measures from 3" to 4", the intermediate from 4" to 5", and the short one from 5" to 6".
Each anvil is provided with separate means of adjustment for wear. They are easily and quickly inserted in the frame, and are held solidly to their bearings by a knurled nut.
Means of adjustment for the measuring screw are also provided.
This Caliper is also made to measure all sizes above 75 and less than 150 millimetres by hundredths of a millimetre.

Standards.

A set of three Standards is furnished when desired.

Price, per Set, $4 00.

MICROMETER CALIPER No. 57.

English or Metric Measure.

Price, with Standards, $30 00. With Ratchet Stop, $30 50.
Price, without Standards, $20 00. With Ratchet Stop, $20 50.

This Caliper differs from Micrometer Caliper No. 55 only in that it measures all sizes from 6" to 12" in length and 12" in diameter by thousandths of an inch.
Six anvils, or measuring points, are furnished; and measure respectively, 11" to 12", 10" to 11", 9" to 10", 8" to 9", 7" to 8" and 6" to 7".
Each anvil is provided with separate means of adjustment for wear.
This Caliper is also made to measure all sizes above 150 and less than 300 millimetres by hundredths of a millimetre.

Standards.

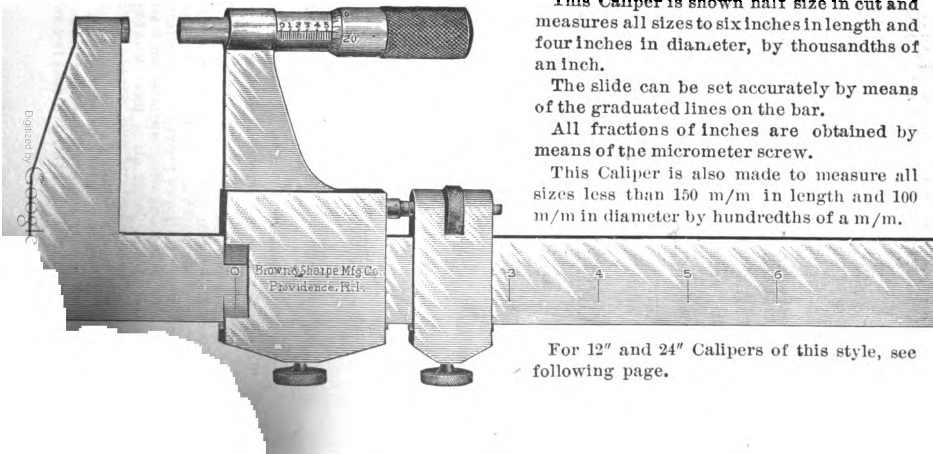
A set of six Standards is furnished when desired.

Price, per Set, $10 00.

A set of Standards, used in adjusting the Caliper, is sent with each of the above unless otherwise ordered.

MICROMETER CALIPER No. 60.

English or Metric Measure.



Price, $30 00

This Caliper is shown half size in cut and measures all sizes to six inches in length and four inches in diameter, by thousandths of an inch.

The slide can be set accurately by means of the graduated lines on the bar.

All fractions of inches are obtained by means of the micrometer screw.

This Caliper is also made to measure all sizes less than 150 m/m in length and 100 m/m in diameter by hundredths of a m/m.

For 12″ and 24″ Calipers of this style, see following page.

MICROMETER CALIPER No. 64.

English or Metric Measure. Price, $35 00.

This Caliper, similar in design to Micrometer Caliper No. 60, is made to measure all sizes to twelve inches in length and six inches in diameter by thousandths of an inch.

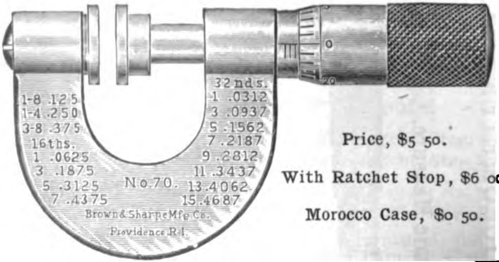
MICROMETER CALIPER No. 68.

English or Metric Measure. Price, $45 00.

This Caliper, similar in design to Micrometer Caliper No. 60, is made to measure all sizes to twenty-four inches in length and six inches in diameter by thousandths of an inch.

PAPER GAUGE MICROMETER CALIPER No. 70.

English or Metric Measure.



Price, $5 50.

With Ratchet Stop, $6 00.

Morocco Case, $0 50.

This Paper Gauge Micrometer Caliper is shown full size and measures all sizes less than three-eighths of an inch, by thousandths of an inch.

In measuring the thickness of paper, cardboard, sheet rubber or other yielding substances, it is advantageous to use Micrometer Calipers provided with discs or washers on the ends of the measuring spindle and adjusting screw. The comparatively large sizes have less tenden[illegible] press the objects measured and enable accur[illegible] ments to be quickly obtained.

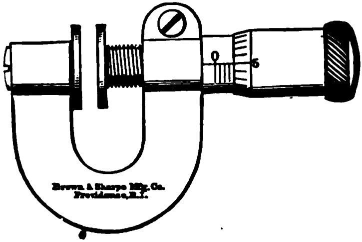
This Caliper is also made to measure all [illegible] ne millimetres by hundredths of a millim[illegible] de, the table of decimal equivalents is on[illegible]

PAPER GAUGE

MICROMETER CALIPER No. 71.

English Measure.

Price, $5 00. In Morocco Case, $5 50.



This Paper Gauge Micrometer Caliper, or Micrometer Caliper with Large Measuring Surfaces, shown full size in cut, is particularly well adapted for carrying in the pocket. It measures all sizes less than one-quarter inch by thousandths of an inch.

In measuring the thickness of paper, cardboard, sheet rubber, or other yielding surfaces, it is advantageous to use Micrometer Calipers, provided with discs or washers on the ends of the measuring spindle and adjusting screw. The comparatively large surfaces have less tendency to compress the objects measured, and enable accurate measurements to be quickly obtained.

MICROMETER CALIPER No. 72, Rolling Mill Gauge.

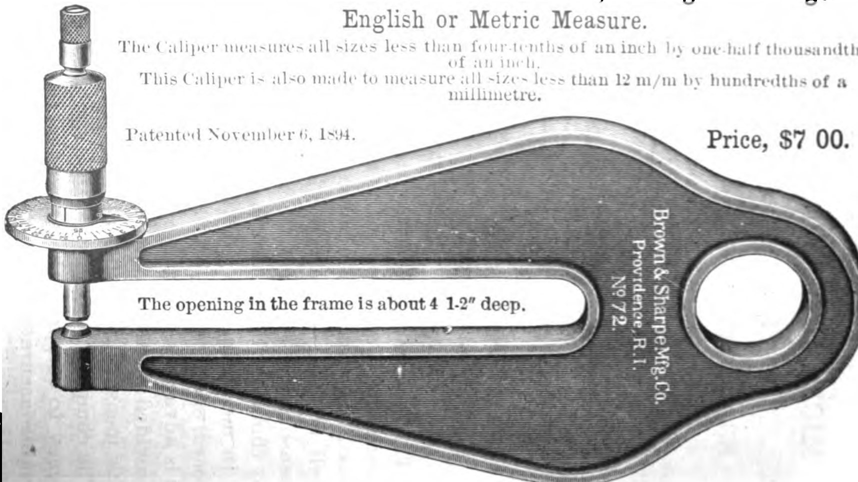
English or Metric Measure.

The Caliper measures all sizes less than four-tenths of an inch by one-half thousandths of an inch.

This Caliper is also made to measure all sizes less than 12 m/m by hundredths of a millimetre.

Patented November 6, 1894.

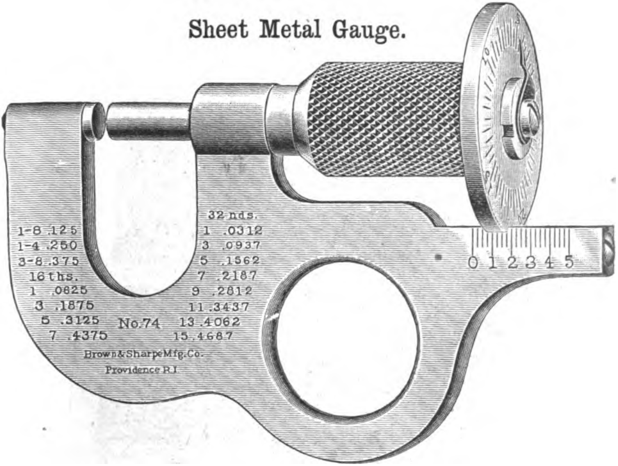
Price, $7 00.



The opening in the frame is about 4 1-2″ deep.

MICROMETER CALIPER No. 74.

Sheet Metal Gauge.



Price, $5 50. Morocco Case, $0 50.

This Micrometer Caliper, shown full size, is recommended as especially convenient for sheet metal workers and handlers.

By placing the middle finger of the right hand through the ring, the Caliper is readily held at right angles to the sheet to be measured and readings made while in this position. The thimble can be operated by the forefinger and thumb of the same hand.

The Caliper measures all sizes less than four-tenths of an inch by one-half thousandths of an inch, but one-quarter thousandths are readily estimated.

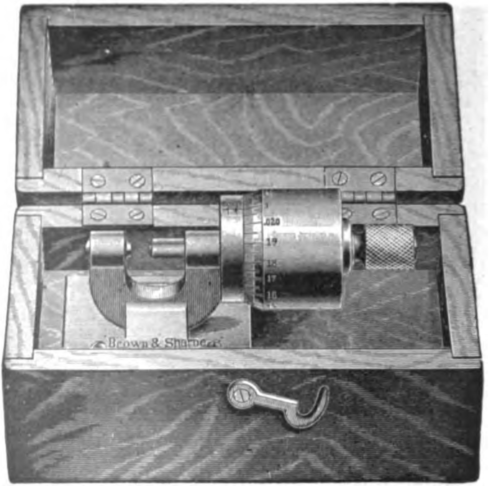
To facilitate the reading of the Caliper while held in position, the one-half thousandths readings are taken from the dial at the top of the spindle, the readings being indicated by the pointer; and the twenty-five thousandths readings, or those corresponding to the readings on the barrel of an ordinary Micrometer Caliper, are taken from the scale at the end of the frame.

The decimal equivalents stamped on the frame are convenient and render possible the imm[illegible] expression of readings in 8ths, 16ths, 32ds and 64ths of

MICROMETER CALIPER No. 75.

English or Metric Measure.

Price, in Cherry Case, $15 00.



This Caliper is shown half size in cut and measures all sizes less than one-half inch by *ten-thousandths* of an inch. The measurements can be read directly from the barrel; the screw has fifty threads and the barrel is divided into two hundred equal parts.

This Caliper is found of service to wire drawers, watchmakers and others who desire fine measurements, and whose work is of such a class that a Micrometer Caliper can be used when placed on a bench.

This Caliper is also made to measure all sizes less than thirteen millimetres by hundredths of a millimetre.

MICROMETER CALIPERS

Nos. 83, 84, 85 and 86.

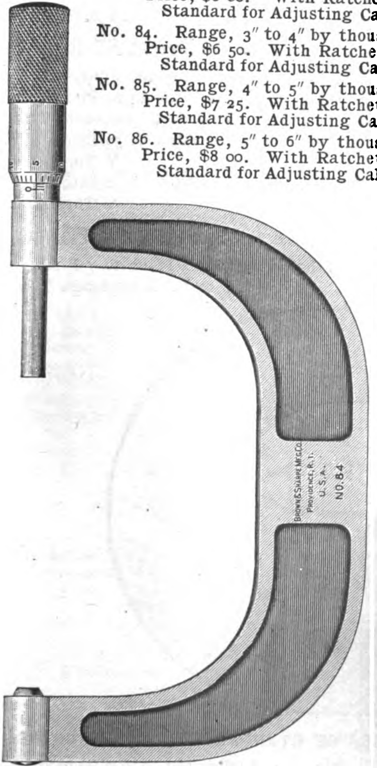
ENGLISH OR METRIC MEASURE.

No. 83. Range, 2″ to 3″ by thousandths of an inch.
Price, $6 00. With Ratchet Stop, $6 50.
Standard for Adjusting Caliper, $1 00.

No. 84. Range, 3″ to 4″ by thousandths of an inch.
Price, $6 50. With Ratchet Stop, $7 00.
Standard for Adjusting Caliper, $1 15.

No. 85. Range, 4″ to 5″ by thousandths of an inch.
Price, $7 25. With Ratchet Stop, $7 75.
Standard for Adjusting Caliper, $1 35.

No. 86. Range, 5″ to 6″ by thousandths of an inch.
Price, $8 00. With Ratchet Stop, $8 50.
Standard for Adjusting Caliper, $1 50.



These Micrometer Calipers are made to meet the demand for an inexpensive, yet accurate measuring tool. They are more convenient for general use than the bar Micrometer or Vernier, as they can be more readily set for the different measurements and are more easily handled where rapid measurements are required.

The frame is of I section, thus combining the greatest rigidity and strength with lightness.

Metric Measure.

These Calipers are also made to read to h[illegible] dredths of [illegible] limetre[illegible]

SCREW THREAD MICROMETER CALIPERS.

1-2 inch, Price, $7 00.

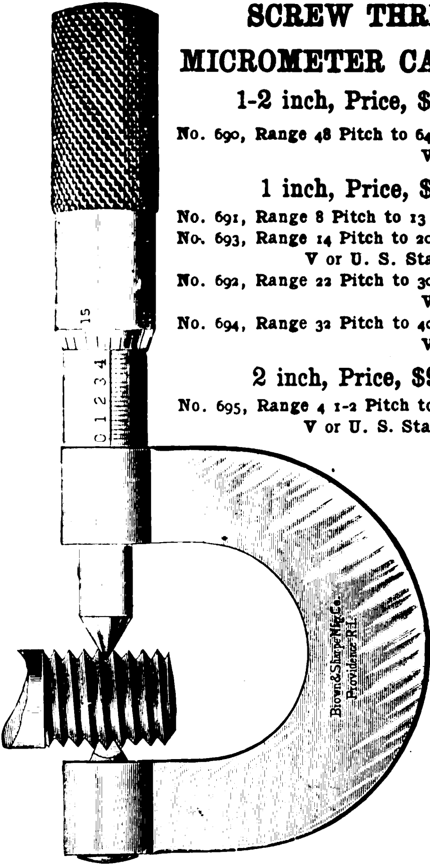
No. 690, Range 48 Pitch to 64 Pitch.
V Threads only.

1 inch, Price, $7 50.

No. 691, Range 8 Pitch to 13 Pitch.
No. 693, Range 14 Pitch to 20 Pitch.
V or U. S. Standard Threads.
No. 692, Range 22 Pitch to 30 Pitch.
V Threads only.
No. 694, Range 32 Pitch to 40 Pitch.
V Threads only.

2 inch, Price, $9 00.

No. 695, Range 4 1-2 Pitch to 7 Pitch.
V or U. S. Standard Threads.



OTHER RANGES OR STANDARDS MADE TO ORDER.

Prices on Application.

SCREW THREAD MICROMETER CALIPER.

This Caliper is intended for the accurate measurement of V threads on screws, standard screws, taps, thread gauges etc., by measuring the actual thread.

The distinctive feature in the construction of this Caliper is that the end of the movable spindle is pointed and the fixed end or "anvil" is V shaped. Enough is taken from the end of the point and the bottom of the V is carried down low enough, so that they will not rest on the bottom or top of the thread to be measured but on the cut surface. As the thread itself is measured, it will be seen that the actual outside diameter of the piece does not enter into consideration.

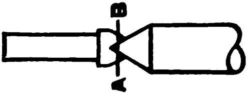
As we measure one-half of the depth of the thread from the top, on each side, the diameter of the thread as indicated by the Caliper, or the pitch diameter, is the full size of the thread less the depth of one thread.

This depth may he found as follows :

Depth of V threads = .866 ÷ number of threads to 1".
" " U. S. Std. " = .6495 ÷ " " " "
" " Whitworth " = .64 ÷ " " " "

As the U. S. standard thread is flatted 1-8 of its own depth on top, it follows that the pitch diameter of the thread is increased 1-8 on each side, equaling 1-4 of the whole depth and instead of the constant .866 we use the constant .6495, which is 3-4 of .866.

When the point and anvil are in contact the 0 represents a line drawn through the plane A B



and if the caliper is opened, say to .500, it represents the distance of the two planes .500" apart.

While the movable point measures all pitches, the fixed "anvil" is limited in its capacity, for if made large enough to measure a 4 pitch thread it would be too wide at the top to measure a 24 pitch thread and if made to measure a 24 pitch thread it would be so small that the thread would not obtain a proper bearing in the anvil. Thus each caliper is limited in the range of threads that the anvil can measure and in making inquiries, or giving orders, if customers will give information as to the range of threads that they wish to measure, we will advise as to the caliper or calipers best suited to measure that range.

TABLE

FOR USE IN CONNECTION WITH

Brown & Sharpe Mfg. Co.'s Screw Thread Micrometer Caliper.

READING OF CALIPER

For "V" Threads $= D - \frac{.866}{P}$

"V" THREADS.

Diam.	Pitch.	Caliper Reading.		Diam.	Pitch.	Caliper Reading.	
D	P	$D-\frac{.866}{P}$	$\frac{.866}{P}$	D	P	$D-\frac{.866}{P}$	$\frac{.866}{P}$
	64		.0135	1-4	24	.2139	.0361
	62		.0140	1-4	20	.2067	.0433
	60		.0144	5-16	20	.2692	.0433
	58		.0149	5-16	18	.2644	.0481
	56		.0155	3-8	18	.3269	,0481
	54		.0160	3-8	16	.3209	.0541
	52		.0167	7-16	16	.3834	.0541
	50		.0173	7-16	14	.3756	.0619
	48		.0180	1-2	14	.4381	.0619
	46		.0188	1-2	13	.4334	.0666
	44		.0197	1-2	12	.4278	.0722
	42		.0206	9-16	14	.5006	.0619
	40		.0217	9-16	12	.4903	.0722
	38		.0228	5-8	11	.5463	.0787
	36		.0241	5-8	10	.5384	.0866
	34		.0255	11-16	10	.6009	.0866
	32		.0271	3-4	10	.6634	.0866
	30		.0289	7-8	9	.7788	.0962
	28		.0309	1	8	.8918	.1082
	26		.0333	1 1-8	8	1.0168	.1082
				1 1-4	7	1.1263	.1237
				1 1-2	6	1.3557	.1443

As there is no standard of diameter for the finer pitches, the columns for diameter and caliper reading are left blank. The column on the right gives the number to be subtracted from the diameter to obtain the caliper reading.

TABLE

FOR USE IN CONNECTION WITH

Brown & Sharpe Mfg. Co.'s Screw Thread Micrometer Caliper.

READING OF CALIPER

For U. S. Threads $= D - \frac{.6495}{P}$

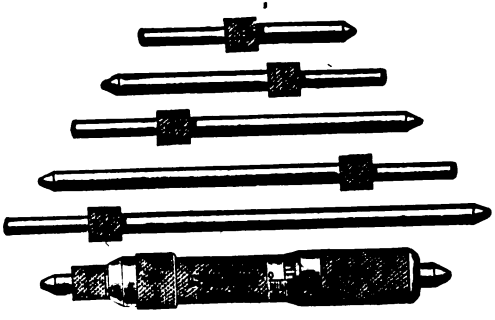
U. S. STANDARD THREADS.

Diam.	Pitch.	Caliper Reading.		Diam.	Pitch.	Caliper Reading.	
D	P	$D - \frac{.6495}{P}$	$\frac{.6495}{P}$	D	P	$D - \frac{.6495}{P}$	$\frac{.6495}{P}$
	64		.0101	1-4	20	.2176	.0324
	62		.0105	5-16	18	.2765	.0360
	60		.0108	3-8	16	.3344	.0406
	58		.0112	7-16	14	.3911	.0464
	56		.0116	1-2	13	.4501	.0499
	54		.0120	9-16	12	.5084	.0541
	52		.0125	5-8	11	.566	.0590
	50		.0130	3-4	10	.6851	.0649
	48		.0135	7-8	9	.8029	.0721
	46		.0141	1	8	.9188	.0812
	44		.0148	1 1-8	7	1.0322	.0928
	42		.0155	1 1-4	7	1.1572	.0928
	40		.0162	1 3-8	6	1.2668	.1082
	38		.0171	1 1-2	6	1.3918	.1082
	36		.0180	1 5-8	5½	1.507	.1180
	34		.0191	1 3-4	5	1.6201	.1299
	32		.0203	1 7-8	5	1.7451	.12[illegible]
	30		.0217	2	4½	1.8557	.1[illegible]
	28		.0232	2 1-2	4	2.3376	.1[illegible]
	26		.0250	3	3½	2.8145	.18[illegible]
	24		.0271	3 1-2	3¼	3.3002	.19[illegible]
	22		.0295	4	3	3.7835	.216[illegible]

As there is no standard of diameter for the finer pitches the columns for diameter and caliper reading are left blank. The column on the right gives the number to be subtracted from the diameter to obtain the caliper reading.

INSIDE MICROMETER GAUGE.

English or Metric Measure.



No. 799.

Price, in Morocco Case, $4 00.

The Inside Micrometer Gauge, shown about two-thirds size in cut, is designed for making internal measurements, as in measuring rings, cylinders, setting callipers, comparing gauges, and work of a similar character. It is also well adapted for measuring parallel surfaces.

The Gauge consists of a holder provided with a micrometer screw and thimble. The screw has a movement of 1-2″; and, by the use of the extension rods furnished, measurements from 3″ to 6″ can be made by thousandths of an inch.

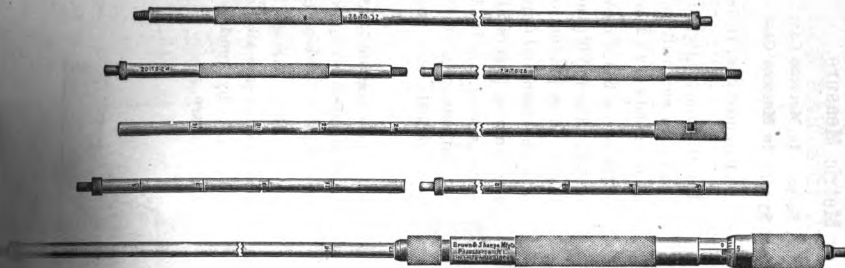
The extension rods vary by 1-2″, and each rod is provided with an adjusting nut and a check-nut, which are set to obtain the proper measurement of the given rod, and should be adjusted only when the point of that rod has become worn.

Provision is made for adjustment to compensate for wear of the screw and measuring surfaces. The measuring surfaces are hardened.

Metric Measure. This Inside Micrometer Gauge is also made to measure all distances from **70 m/m to 190 m/m** by hundredths of a millimetre.

INSIDE MICROMETER GAUGES.

English or Metric Measure.



No.	Number of Rods.	Range.	Price in Case.
800	5	2 1-2″ to 10″	$4 50
800A	6	70 m/m to 250 m/m	4 50
801	7	2 1-2″ to 13″	5 50
801A	8	70 m/m to 310 m/m	5 50
802	7	8″ to 32″	7 00
802A	7	200 m/m to 800 m/m	7 00

These Gauges consist of a holder with a micrometer screw and thimble graduated to read to .001″.

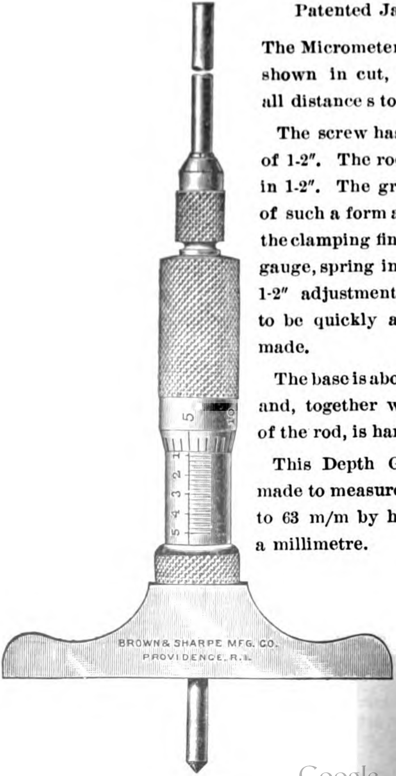
The extension rods are graduated by a series of angular grooves of a form and depth that allow the clamping fingers to spring in, and the adjustments quickly and positively made.

Metric Measures. These Gauges are also made to read to 1-100 m/m.

MICROMETER DEPTH GAUGES.

English or Metric Measure.

No. 810.	2" Base.	Price, $4 50.	In Morocco Case, $5 00.
No. 812.	4" Base.	Price, $5 00.	In Morocco Case, $5 50.



Patented Jan. 11, 1898.

The Micrometer Depth Gauge shown in cut, will measure all distance s to 2 1-2" by .001".

The screw has a movement of 1-2". The rod is graduated in 1-2". The graduations are of such a form and depth that the clamping fingers, at end of gauge, spring in, allowing the 1-2" adjustments of the rod to be quickly and positively made.

The base is about 7-16" thick, and, together with the point of the rod, is hardened.

This Depth Gauge is also made to measure all distances to 63 m/m by hundredths of a millimetre.

DECIMAL EQUIVALENTS

OF PARTS OF AN INCH.

1/64	.01563	21/64	.32813	45/64	.70313
1/32	.03125	11/32	.34375	23/32	.71875
3/64	.04688	23/64	.35938	47/64	.73438
1/16	.0625	3/8	.375	3/4	.75
5/64	.07813	25/64	.39063	49/64	.76563
3/32	.09375	13/32	.40625	25/32	.78125
7/64	.10938	27/64	.42188	51/64	.79688
1/8	.125	7/16	.4375	13/16	.8125
9/64	.14063	29/64	.45313	53/64	.82813
5/32	.15625	15/32	.46875	27/32	.84375
11/64	.17188	31/64	.48438	55/64	.85938
3/16	.1875	1/2	.5	7/8	.875
13/64	.20313	33/64	.51563	57/64	.89063
7/32	.21875	17/32	.53125	29/32	.90625
15/64	.23438	35/64	.54688	59/64	.92188
1/4	.25	9/16	.5625	15/16	.9375
17/64	.26563	37/64	.57813	61/64	.95313
9/32	.28125	19/32	.59375	31/32	.96875
19/64	.29688	39/64	.60938	63/64	.98438
5/16	.3125	5/8	.625	1	1.00000
		[illegible]	.64063		
		[illegible]	.65625		
		[illegible]	.67188		
		11/16	.6875		

TABLE OF DECIMAL EQUIVALENTS
OF MILLIMETRES
AND FRACTIONS OF MILLIMETRES.

mm.	Inches.	mm.	Inches.	mm.	Inches.	mm.	Inches.
$\frac{1}{100}$	=.00039	$\frac{33}{100}$	=.01299	$\frac{64}{100}$	=.02520	$\frac{95}{100}$	=.03740
$\frac{2}{100}$	=.00079	$\frac{34}{100}$	=.01339	$\frac{65}{100}$	=.02559	$\frac{96}{100}$	=.03780
$\frac{3}{100}$	=.00118	$\frac{35}{100}$	=.01378	$\frac{66}{100}$	=.02598	$\frac{97}{100}$	=.03819
$\frac{4}{100}$	=.00157	$\frac{36}{100}$	=.01417	$\frac{67}{100}$	=.02638	$\frac{98}{100}$	=.03858
$\frac{5}{100}$	=.00197	$\frac{37}{100}$	=.01457	$\frac{68}{100}$	=.02677	$\frac{99}{100}$	=.03898
$\frac{6}{100}$	=.00236	$\frac{38}{100}$	=.01496	$\frac{69}{100}$	=.02717	1	=.03937
$\frac{7}{100}$	=.00276	$\frac{39}{100}$	=.01535	$\frac{70}{100}$	=.02756	2	=.07874
$\frac{8}{100}$	=.00315	$\frac{40}{100}$	=.01575	$\frac{71}{100}$	=.02795	3	=.11811
$\frac{9}{100}$	=.00354	$\frac{41}{100}$	=.01614	$\frac{72}{100}$	=.02835	4	=.15748
$\frac{10}{100}$	=.00394	$\frac{42}{100}$	=.01654	$\frac{73}{100}$	=.02874	5	=.19685
$\frac{11}{100}$	=.00433	$\frac{43}{100}$	=.01693	$\frac{74}{100}$	=.02913	6	=.23622
$\frac{12}{100}$	=.00472	$\frac{44}{100}$	=.01732	$\frac{75}{100}$	=.02953	7	=.27559
$\frac{13}{100}$	=.00512	$\frac{45}{100}$	=.01772	$\frac{76}{100}$	=.02992	8	=.31496
$\frac{14}{100}$	=.00551	$\frac{46}{100}$	=.01811	$\frac{77}{100}$	=.03032	9	=.35433
$\frac{15}{100}$	=.00591	$\frac{47}{100}$	=.01850	$\frac{78}{100}$	=.03071	10	=.39370
$\frac{16}{100}$	=.00630	$\frac{48}{100}$	=.01890	$\frac{79}{100}$	=.03110	11	=.43307
$\frac{17}{100}$	=.00669	$\frac{49}{100}$	=.01929	$\frac{80}{100}$	=.03150	12	=.47244
$\frac{18}{100}$	=.00709	$\frac{50}{100}$	=.01969	$\frac{81}{100}$	=.03189	13	=.51181
$\frac{19}{100}$	=.00748	$\frac{51}{100}$	=.02008	$\frac{82}{100}$	=.03228	14	=.55118
$\frac{20}{100}$	=.00787	$\frac{52}{100}$	=.02047	$\frac{83}{100}$	=.03268	15	=.59055
$\frac{21}{100}$	=.00827	$\frac{53}{100}$	=.02087	$\frac{84}{100}$	=.03307	16	=.62992
$\frac{22}{100}$	=.00866	$\frac{54}{100}$	=.02126	$\frac{85}{100}$	=.03346	17	=.66929
$\frac{23}{100}$	=.00906	$\frac{55}{100}$	=.02165	$\frac{86}{100}$	=.03386	18	=.70866
$\frac{24}{100}$	=.00945	$\frac{56}{100}$	=.02205	$\frac{87}{100}$	=.03425	19	=.74803
$\frac{25}{100}$	=.00984	$\frac{57}{100}$	=.02244	$\frac{88}{100}$	=.03465	20	=.78740
$\frac{26}{100}$	=.01024	$\frac{58}{100}$	=.02283	$\frac{89}{100}$	=.03504	21	=.82677
$\frac{27}{100}$	=.01063	$\frac{59}{100}$	=.02323	$\frac{90}{100}$	=.03543	22	=.86614
$\frac{28}{100}$	=.01102	$\frac{60}{100}$	=.02362	$\frac{91}{100}$	=.03583	23	=.90551
$\frac{29}{100}$	=.01142	$\frac{61}{100}$	=.02402	$\frac{92}{100}$	=.03622	24	=.94488
$\frac{30}{100}$	=.01181	$\frac{62}{100}$	=.02441	$\frac{93}{100}$	=.03661	25	=.98425
$\frac{31}{100}$	=.01220	$\frac{63}{100}$	=.02480	$\frac{94}{100}$	=.03701	26	=1.02362
$\frac{32}{100}$	=.01260						

FRENCH OR METRIC MEASURES.

The metric unit of length is the metre = 39.37 inches.

The metric unit of weight is the gram = 15.432 grains.

The following prefixes are used for sub-divisions and multiples: Milli = $\frac{1}{1000}$, Centi = $\frac{1}{100}$, Deci = $\frac{1}{10}$, Deca = 10, Hecto = 100, Kilo = 1000, Myria = 10,000.

French and British (and American) Equivalent Measures.

MEASURES OF LENGTH.

French.		British and U. S.
1 metre	=	39.37 inches, or 3.28083 feet, 1.09361 yds.
.3048 metre	=	1 foot.
1 centimetre	=	.3937 inch.
2.54 centimetres	=	1 inch.
1 millimetre	=	.03937 inch, or nearly 1-25 inch.
25.4 millimetres	=	1 inch.
1 kilometre	=	1093.61 yards, or 0.62137 mile.

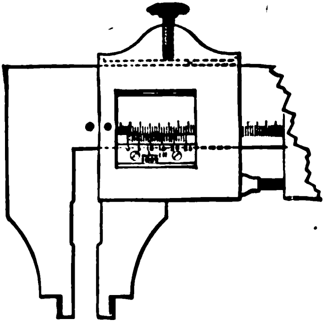
OF WEIGHT.

French.		British and U. S.
1 gramme	=	15.432 grains.
.0648 gramme	=	1 grain.
28.35 gramme	=	1 ounce avoirdupois.
1 kilogramme	=	2.2046 pounds.
.4536 kilogramme	=	1 pound.
1 tonne or metric ton 1000 kilogrammes	=	.9842 ton of 2240 pounds. 19.68 cwt. 2204.6 pounds.
1.016 metric tons 1016 kilogrammes	=	1 ton of 2240 pounds.

OF CAPACITY.

French.		British and U. S.
1 litre (= 1 cubic decimetre)	=	61.023 cu[illegible] inches. .03531 [illegible] feet. .2642 g[illegible]an). 2.202 lb[illegible] 62° F.
28.317 litres . .	=	1 cubic fo[illegible]
4.543 litres . .	=	1 gallon ([illegible]
3.785 litres . .	=	1 gallon (Am[illegible]

DESCRIPTION OF THE VERNIER AND ITS USE.



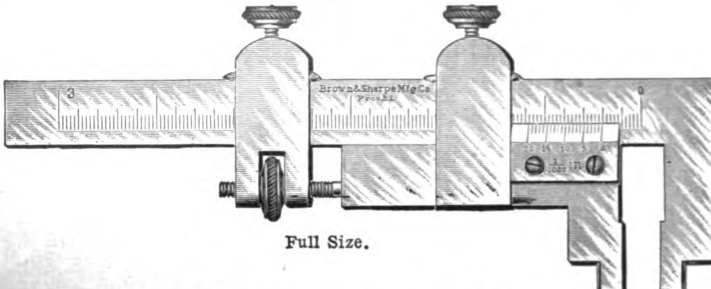
On the bar of the instrument is a line of inches numbered 0, 1, 2 etc., each inch being divided into ten parts and each tenth into four parts, making forty divisions to the inch. On the sliding jaw is a line of division (called a Vernier, from the inventor's name) of twenty-five parts, numbered 0, 5, 10, 15, 20, 25. The twenty-five par s on the Vernier correspond, in extreme length, with twenty-four parts or twenty-four fortieths of the bar, consequently each division on the Vernier is smaller than each division on the bar by one thousandth part of an inch. If the sliding jaw of the Caliper is pushed up to the other, so that the line marked 0 on the Vernier corresponds with that marked 0 on the bar, then the two next lines to the right will differ from each other by one thousandth of an inch and so the difference will continue to increase, one thousandth of an inch for each division, till they again correspond at the line marked 25 on the Vernier. To read the distance the Caliper is open, commence by noticing how many inches, tenths and parts of tenths, the zero point on the Vernier has been moved from the zero point on the bar. Now count upon the Vernier the number of divisions, until one is found which coincides with one on the bar, which will be the number of thousandths to be added to the distance read off on the bar. The best way of expressing the value of the divisions on the bar, is to call the tenths one hundred thousandths (.100) and the fourths of tenths, or fortieths, twenty-five thousandths (.025). Referring to the cut on preceding page, it will be seen that the jaw is open two-tenths and three quarters, which is equal to two hundred and seventy-five thousandths (.275). Now suppose the Vernier was moved to the right so that the tenth division should coincide with the next one on the scale, which will make ten thousandths (.010) more to be added to two hundred and seventy-five thousandths (.275), making the jaws open two hundred and eighty-five thousandths (.285).

In making inside measurements with the 6″ Vernier and the Pocket Vernier Calipers, two and one-half tenths or two hundred and fifty thousandths (.250) of an inch and with the 12″ and 24″ [illegible]erniers, three tenths or three hundred thousa[illegible]ths (.300) of an inch should be added to the app[illegible] read[illegible]ing on the Vernier side for the space occu[illegible] by [illegible]he caliper points. When the other side o[illegible]-ment is used, no deduction is necessa[illegible] are two lines, one indicating inside [illegible] outside measurements.

POCKET VERNIER CALIPER.

English or Metric Measure.

No. 680. **Price, $10 00.** **In Morocco Case, $10 50.**



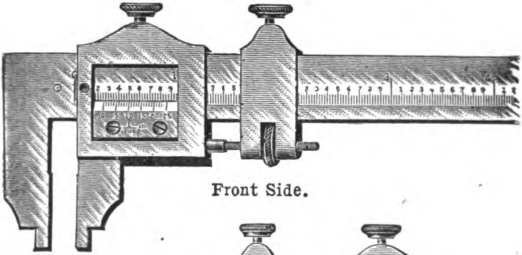
Full Size.

This Pocket Vernier Caliper is graduated on the front to read, by means of a vernier, to thousandths of an inch. It is graduated on the back to 64ths of an inch. The jaws are of steel, hardened and ground, are 3-4" long, 1-4" wide when closed, and take inside as well as outside measurements. The Caliper measures to 1 11-16" outside diameter.

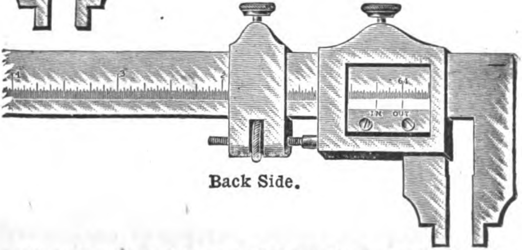
This Caliper is furnished graduated to millimetres in place of 64ths of an inch, with a vernier to read to 50ths of a millimetre.

An explanation of the vernier is sent with each Caliper.

VERNIER CALIPERS.



Front Side.



Back Side.

These Calipers are graduated on the front to read, by means of a vernier, to thousandths of an inch. They are graduated on the back to 64ths of an inch. The jaws are hardened and ground and take inside as well as outside measurements. Points are placed on the bars and slides so that dividers can be set to transfer distances.

These Calipers are also furnished graduated on one side to read to 1-50th of a millimetre and to .001 of an inch on the other.

An explanation of the vernier is sent with each Caliper.

No.	Size.	Length of Jaws.	Width of [illegible] cl[illegible]	Price in Case.
682	6″	1 1-4″	1[illegible]	$15 00
686	12	2 1-4	3[illegible]	20 00
688	24	2 1-4	3[illegible]	[illegible]5 00

A Standard is furnished when desir[illegible] the accuracy of the adjustment of the Caliper[illegible]

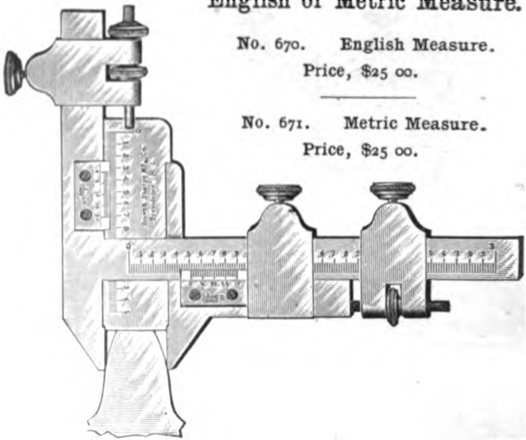
Price, $3 00.

GEAR TOOTH CALIPER.

English or Metric Measure.

No. 670. English Measure.
Price, $25 00.

No. 671. Metric Measure.
Price, $25 00.



This Caliper is for the purpose of accurately measuring the distance from top to pitch line, and thickness at pitch line of gear teeth.

It will measure all pitches from 20 diametral to 2 diametral.

The sliding jaw moves upon a bar graduated to read, by means of a Vernier, to thousandths of an inch. A tongue, moving at right angles with the jaws, is graduated in the same manner

Both the sliding jaw and tongue are provided with adjusting screws.

Metric Measure. This Caliper is also graduated to read to 1-50th of a millimetre and measures all pitches from 1 1-4 m/m to 12 m/m.

HEIGHT GAUGE.

English or Metric Measure.

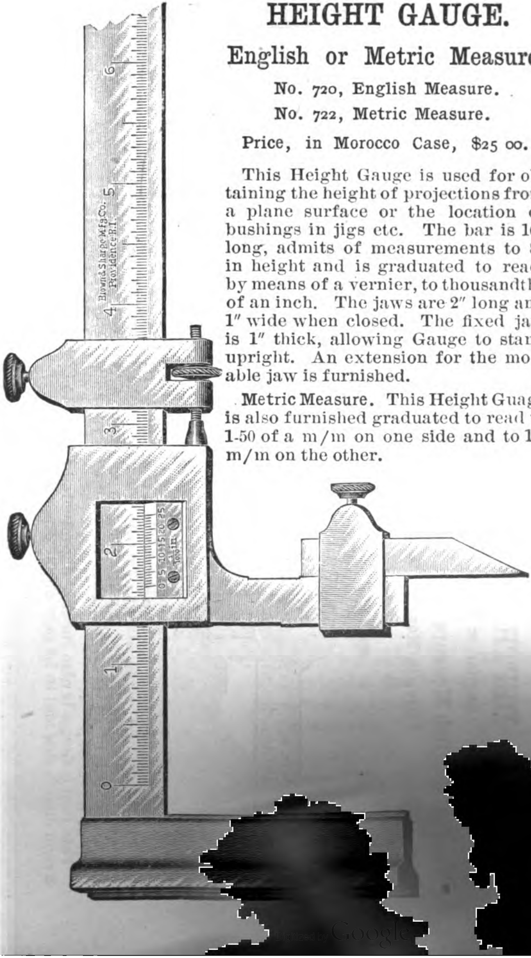
No. 720, English Measure.

No. 722, Metric Measure.

Price, in Morocco Case, $25 00.

This Height Gauge is used for obtaining the height of projections from a plane surface or the location of bushings in jigs etc. The bar is 10″ long, admits of measurements to 8″ in height and is graduated to read, by means of a vernier, to thousandths of an inch. The jaws are 2″ long and 1″ wide when closed. The fixed jaw is 1″ thick, allowing Gauge to stand upright. An extension for the movable jaw is furnished.

Metric Measure. This Height Guage is also furnished graduated to read to 1-50 of a m/m on one side and to 1-2 m/m on the other.

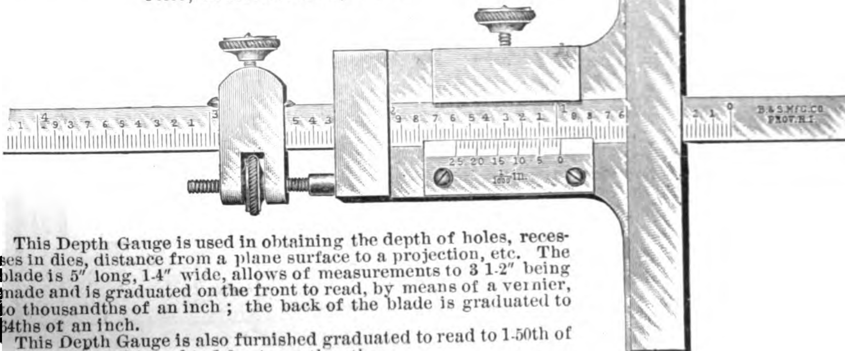


DEPTH GAUGES.

English or Metric Measure.

No. 714, English Measure. No. M714, Metric Measure.

Price, in Morocco Case, $10 00.



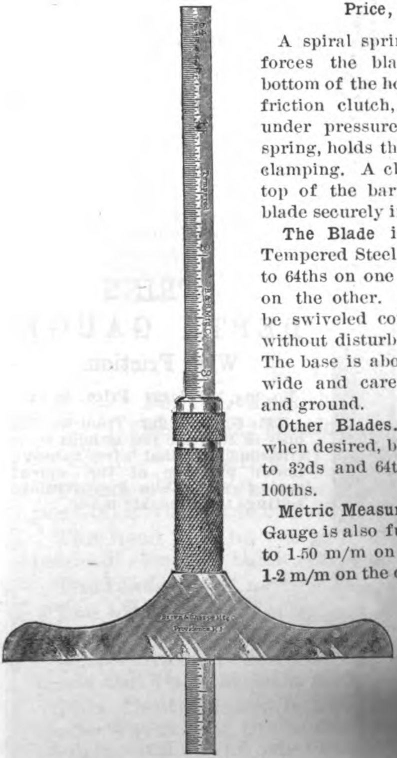
This Depth Gauge is used in obtaining the depth of holes, recesses in dies, distance from a plane surface to a projection, etc. The blade is 5″ long, 1-4″ wide, allows of measurements to 3 1-2″ being made and is graduated on the front to read, by means of a vernier, to thousandths of an inch; the back of the blade is graduated to 64ths of an inch.

This Depth Gauge is also furnished graduated to read to 1-50th of a m/m on one side and to 1-2 m/m on the other.

UNIVERSAL DEPTH GAUGE.

No. 711, English Measure.

No. 712, Metric Measure.



Price, $3 oo.

A spiral spring in the barrel forces the blade against the bottom of the hole or recess. A friction clutch, free to move under pressure of the spiral spring, holds the blade without clamping. A clamp nut at the top of the barrel clamps the blade securely in position.

The Blade is a narrow 6″ Tempered Steel Rule graduated to 64ths on one side and 100ths on the other. The blade can be swiveled completely round without disturbing the setting. The base is about 3″ long, 7-16″ wide and carefully hardened and ground.

Other Blades. We furnish, when desired, blades graduated to 32ds and 64ths or 50ths and 100ths.

Metric Measure. This Depth Gauge is also furnished to read to 1-50 m/m on one side and to 1-2 m/m on the other.

SPRING DEPTH GAUGES.

No. 713. 2" Base. Price, $1 50.
No. 717. 4" Base. Price, $2 00.

The cut shows the head of the Depth Gauge together with a portion of the barrel and rod. It will measure to 3" in depth.

The base is about 7-16" wide and the rod about 1-8" in diameter.

A spiral spring in the barrel forces the rod against the bottom of the hole or recess to be measured and by use of the clamp screw the rod is securely locked in position.

The base and lower end of the rod are both hardened.

SPRING DEPTH GAUGE.

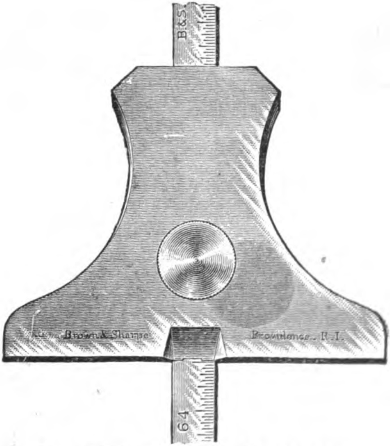
With Friction.

No. 725. 3" Base. Price, $2 25.

This Gauge differs from No. 713 only in that the rod is held by a friction clutch that is free to move under pressure of the spiral spring and enables approximate settings to be quickly made.

6 Inch Rule

DEPTH GAUGE.



No. 715, English Measure.
No. M715, Metric Measure.

Price, $1 25.

The above is a full sized cut of the head and a portion of the blade of a 6″ Rule Depth Gauge.

The head can be conveniently held. It is made of steel 1-8″ thick, hardened.

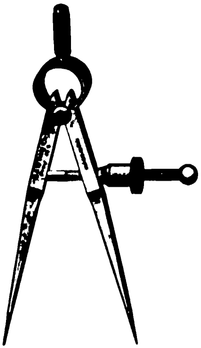
The blade is a 6″ narrow tempered steel rule.

The blade sent with the gauge is divided into 64ths and 100ths of inches.

Will furnish, if desired, blades divided into 32nds and 64ths, or 50ths and 100ths of inches.

This Depth Gauge is also furnished with a blade 15 c/m long, graduated on one corner to 1-5 m/m and on the other corner to 1 m/m.

"BROWN & SHARPE" SPRING DIVIDERS.



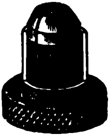
With Spring Nut.

No.	Size.	Price.
948	2 1-2"	$1 15
950	3	1 15
952	4	1 40
954	5	1 40
956	6	1 75

With Solid Nut.

No.	Size.	Price.
949	2 1-2"	$1 00
951	3	1 00
953	4	1 25
955	5	1 25
957	6	1 60

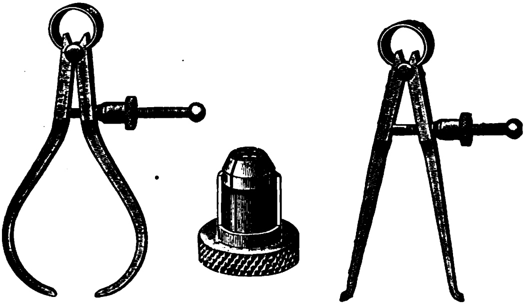
The Spring Nut is a Spring Chuck with hardened jaws. It is positive in action when closing, the thread engaging the hardened screw on the slightest pressure. When the pressure is withdrawn, it slides freely on the screw.



DUPLICATE PARTS
For "Brown & Sharpe" Spring Calipers and Dividers.

Leg,	$0 35
Screw and Ball,	15
Solid Nut,	10
Spring,	25
Spring Nut,	25
Spring Nut Washer,	10
Thumb Attachment,	15

"BROWN & SHARPE" OUTSIDE AND INSIDE SPRING CALIPERS.



Outside. Inside.

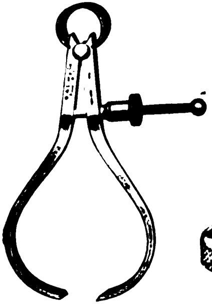
With Spring Nut.

OUTSIDE.			INSIDE.		
No.	Size.	Price.	No.	Size.	Price.
920	2 1-2"	$1 15	940	3"	$1 15
922	3	1 15	942	4	1 25
924	4	1 25	944	5	1 25
926	5	1 25	946	6	1 50
928	6	1 50			

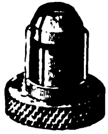
With Solid Nut.

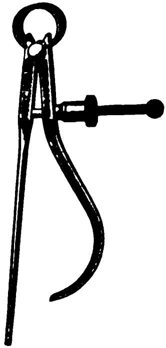
OUTSIDE.			IN[illegible]		
No.	Size.	Price.	No.	Si[illegible]	[illegible]
921	2 1-2"	$1 00	941	3"	[illegible]
923	3	1 00	943	4	[illegible]
925	4	1 10	945	5	[illegible]
927	5	1 10	947	6	[illegible]
929	6	1 35			

"BROWN & SHARPE" THREAD AND KEY-HOLE SPRING CALIPERS.



Thread.





Key-Hole.

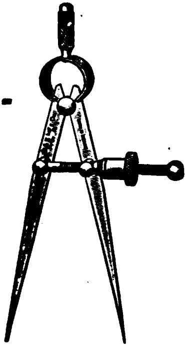
With Spring Nut.

THREAD.			KEY-HOLE.		
No.	Size.	Price.	No.	Size.	Price.
960	3″	$1 15	968	3″	$1 15
962	4	1 25	970	4	1 25
964	5	1 25			

With Solid Nut.

THREAD.			KEY-HOLE.		
No.	Size.	Price.	No.	Size.	[illegible]
961	3″	$1 00	969	3″	[illegible]
963	4	1 10	971	4	[illegible]
965	5	1 10			

REX
SPRING DIVIDERS.



With Spring Nut.

No.	Size.	Price.
1118	2 1-2"	$0 80
1120	3	85
1122	4	90
1124	5	95
1126	6	1 00
1128	8	1 15

With Solid Nut.

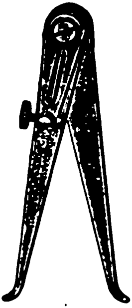
No.	Size.	Price.
1119	2 1-2"	$0 65
1121	3	70
1123	4	75
1125	5	80
1127	6	85
1129	8	1 00

DUPLICATE PARTS
For Rex Calipers and Dividers.

Leg,	$0 25
Screw and Ball,	15
Solid Nut,	10
Spring,	25
Spring Nut,	25
Spring Nut Washer,	10
Thumb At[illegible]ment,	15

SCREW ADJUSTING
FIRM JOINT CALIPERS.

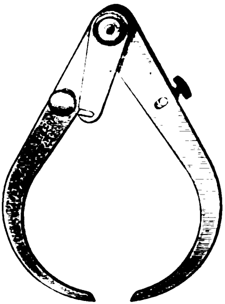
Tempered.

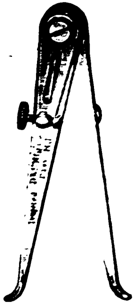


OUTSIDE.			INSIDE.		
No.	Size.	Price.	No.	Size.	Price.
1032	4"	$0 90	1043	4"	$0 90
1033	5	95	1044	5	95
1034	6	1 00	1045	6	1 00
1035	8	1 25	1046	8	1 25
1036	10	1 50	1047	10	1 50
1037	12	1 75	1048	12	1 75
1038	14	2 00	1049	14	2 00
1039	16	2 25	1050	16	2 25
1040	18	2 50	1051	18	2 50
1041	20	2 75	1052	20	2 75
1042	24	3 50	1053	24	3 50

TRANSFER FIRM JOINT CALIPERS.

Tempered.





OUTSIDE.			INSIDE.		
No.	Size.	Price.	No.	Size.	Price.
1066	4″	$1 10	1077	4″	$1 10
1067	5	1 25	1078	5	1 25
1068	6	1 35	1079	6	1 35
1069	8	1 60	1080	8	1 60
1070	10	1 85	1081	10	1 85
1071	12	2 10	1082	12	2 10
1072	14	2 35	1083	14	2 35
1073	16	2 60	1084	16	2 60
1074	18	2 85	[illegible]	[illegible]	2 85
1075	20	3 35	[illegible]	[illegible]	[illegible]
1076	24	4 10	[illegible]	[illegible]	[illegible]

STANDARD STEEL RULES.

Our Shop Standards of Length were carefully compared by the Government Officials with the Standards at Washington.

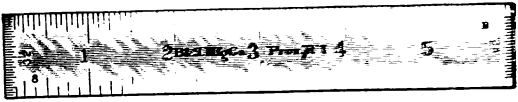
The mean errors were found to be: for the yard, .00002" and for the metre .000005 M., both being too long.

These Standards have been sub-divided with the greatest care and accuracy and Our Rules are as nearly exact copies as expert mechanical skill, aided by special machinery, can make them.

No.	Length.	Number of Graduations.	Price.
100	1"	4 or 7	$0 15
102	2	4, 7 or 9	25
104	3	1, 2, 4, 6 or 7	35
106	4	1, 2, 4, 6 or 7	45
108	6	1, 2, 4, 6 or 7	65
110	9	1, 2, 4, 6 or 7	1 00
112	12	1, 2, 4, 6 or 7	1 25
114	12	5	2 50
116	18	1, 2, 4, 6 or 7	2 00
118	24	1, 2, 4, 6 or 7	2 75
120	24	5	5 00
122	36	1, 2, 4, 6 or 7	5 00
124	48	1, 2, 4, 6 or 7	8 00

STANDARD STEEL RULES.

With Patent End Graduations.



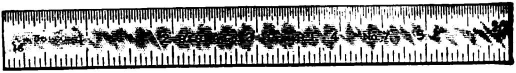
These Rules can be conveniently introduced into grooves, countersinks and recesses of various kinds and are adapted for measuring their depth and width.

They are made of specific widths and the ends are graduated as follows: 2" and 4" Rules to 32nds, 48ths, 56ths and 100ths of an inch; the 6" to 24" Rules to 24ths, 32nds, 48ths and 100ths of an inch; the 3" Rules are graduated to 32nds, 40ths, 48ths and 56ths of an inch.

These Rules are furnished with No. 4 graduations only.

For prices, see list of Standard Rules, page 392.

NARROW STEEL RULE.



No. 130. Price, 65 Cents.

We carry in stock a steel rule, not tempered, 6" long, about 11-16" wide and furnish it with Nos. 1, 2, 4, 6 or 7 graduations.

This rule corresponds to the Standard Steel Rule but is lighter.

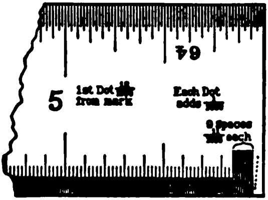
NARROW TEMPERED STEEL RULES.

Every Rule is Marked "Tempered."

These Rules are about 1-20" thick and about 7-32" wide, and graduated on one corner of each side only.

No.	Length.	Number of Graduations.	Price.
157	4"	10, 11 or 12	$0 45
158	6	10, 11 or 12	65
159	9	10, 11 or 12	1 00
159A	12	10, 11 or 12	1 25

IMPROVEMENT IN STANDARD STEEL RULES.



1st Dot, $\frac{12}{1000}$" from line. Each Dot adds $\frac{1}{1000}$"

9 Spaces, $\frac{11}{1000}$" each.

Standard Steel Rules, with No. 7 Graduations, to and including 24" in length, furnished with this device when so ordered without additional cost.

This improvement consists of a series of graduations, at the end of a scale of hundredths, as follows:

Nine spaces of eleven-thousandths of an inch each; and a diagonal line of eight dots, the one nearest the edge of the rule being twelve-thousandths of an inch from the last line, the second thirteen-thousandths, and so on, each dot one-thousandth of an inch further from the line than the one preceding.

By the use of the eleven-thousandth graduations, measurements, from one-tenth of an inch to any length on the scale, can be made by thousandths of an inch; and, by making use of the line of dots, dividers can be set by thousandths from one-hundredth of an inch to any part of the scale.

Method of Using. For measurements less than .100" use:

The long lines shown at the right for measurements that are multiples of 11.

The long lines and 1-100" space lines at the left, for measurements that are the sums of multiples of 10 and 11.

The long lines and dots for measurements not included above.

The following measurements will illustrate the application of the foregoing :

Required Measurement.	Method of Obtaining Measurements.		
	.011″ Spaces.	.010″ Spaces.	Dots.
.051″	1	4	0
.052	2	3	0
.053	3	2	0
.054	4	1	0
.055	5	...	0
.056	5	...	1
.057	5	...	2
.058	5	...	3
.059	5	...	4
.060	...	6	0

When using the eleven-thousandth spaces and the dots, remember that the space between the long line and first dot is the same as one .011″ space plus .001″ and reads .012″.

For measurements greater than .100″, multiply the thousandths figure by 11, and subtract this result from the required measurement. Proceed as follows:

Place one leg of the dividers in the line corresponding to the figure multiplied by 11 and the other leg in the hundredths line, corresponding to the hundredths found in the difference.

For example: To measure .736″, multiply 6 by 11, and subtract the result, 66, from the distance to be measured—.736 — 66 = .670.

Then place one leg of the dividers in the line registering the sixth .011″ space; this, as the first of these lines is 0, will be the seventh line. Read back from this same 0 sixty-seven of the 1-100″ spaces and the dividers will be open .736″.

Required 1.743″. 1.743 — 33 = 1.710. Place one leg of dividers in the fourth long line and the other in the 171st 1-100″ line.

For prices, see page 392.

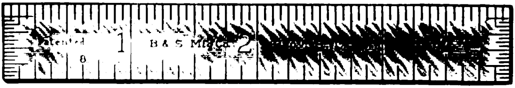
TEMPERED STEEL RULES.

These Rules are about 1-20" thick.
Every Rule is Marked "Tempered."

No.	Length.	Approximate Width.	Number of Graduations.	Price.
136	1"	29-64"	4 or 7	$0 15*
137	2	1-2	4, 7 or 9	25
138	3	35-64	1, 2, 4, 6 or 7	35
139	4	19-32	1, 2, 4, 6 or 7	45
140	6	11-16	1, 2, 4, 6 or 7	65
141	*9	53-64	1, 2, 4, 6 or 7	1 00
142	12	31-32	1, 2, 4, 6 or 7	1 25
143	18	1	1, 2, 4, 6 or 7	2 00
144	24	1	1, 2, 4, 6 or 7	2 50
145	36	1	1, 2, 4, 6 or 7	5 00

TEMPERED STEEL RULES.

With Patent End Graduations.



Patented August 25, 1885.

These Rules are furnished from 2 to 12 inches in length, and with No. 4 Graduations only. They are graduated to 32nds of an inch on two ends of one side.

Prices are the same as given in the above list.

FLEXIBLE STEEL RULES.

Every Rule is Marked "Tempered."
Graduated on One Side Only.

No.	Length.	Approximate Width.	Number of Graduations.	Price.
149	4	1-2"	10, 11, 12, 13 or 14	$0 45
150	6	1-2	10, 11, 12, 13 or 14	65
151	9	1-2	10, 11, 12, 13 or 14	1 00
152	12	1-2	10, 11, 12, 13 or 14	1 25
153	18	3-4	10, 11, 12, 13 or 14	2 00
154	24	3-4	10, 11, 12, 13 or 14	2 75
155	36	3-4	10, 11, 12, 13 or 14	5 00

STANDARD STEEL RULES.

Metric and English Measure.

No. 181, 5 centimetres. 25c. No. 183, 10 centimetres. 45c.

First corner graduated to 1-2 m/m, second corner to 1 m/m, third corner to 1-64 of an inch, fourth corner to 1-100 of an inch.

No. 185, 20 centimetres. 85c. No. 187, 30 centimetres. $1 25.

No. 189, 50 centimetres. $2 00. No. 191, 1 metre. $7 50.

First corner, 5 c/m graduated to 1-2 m/m, the remainder of that corner together with second corner to 1 m/m; third corner, 2 inches to 1-64, the remainder to 1-16 of an inch; fourth corner, 2 inches to 1-100, the remainder to 1-50 of an inch.

STANDARD STEEL RULES.

Metric Measure.

No. 180, 5 centimetres. 25c. No. 182, 10 centimetres. 45c.

First corner graduated to 1-2 m/m, the remaining corners to 1 m/m.

No. 184, 20 centimetres. 85c. No. 186, 30 centimetres. $1 25

Five centimetres of first corner graduated to 1-2 m/m; the remainder of that corner, together with remaining corners, graduated to 1 m/m.

No. 188, 50 centimetres, $2 00.

Five centimetres of each end of first corner graduated to 1-5 m/m; the remainder of that corner, together with the remaining corners, graduated to 1 m/m.

No. 190, 1 metre, $8 00.

Five centimetres of each end of first corner graduated to 1-2 m/m; the remainder of that corner, together with the remaining corners, graduated to 1 m/m.

TEMPERED STEEL RULES.

Metric Measure.

Every Rule is Marked "Tempered."

First corner graduated to 1-2 m/m, remaining three corners to 1 m/m. 20 c/m and 30 c/m Rules have 1-2 m/m for 5 c/m only.

No. 196, 10 centimetres. 45c. No. 197, 20 centimetres, 85c.

No. 198, 30 centimetres. $1 25. No. 199, 50 centimetres, $2 00.

TEMPERED STEEL RULES.

Metric and English Measure.

No. 205, 10 Centimetres, Price, 45 cents.

First corner graduated to 1-64 of an inch, second corner to 1 m/m, third corner to 1-100 of an inch, fourth corner to 1-2 m/m.

No. 206,	20 Centimetres,	Price, 85 cts.
No. 207,	30 Centimetres,	Price, $1 25.
No. 208,	50 Centimetres,	Price, $2 00.

First corner graduated, 2″ to 1-64 of an inch, the remainder to 1-16 of an inch; second corner to 1 m/m; third corner, 2″ to 1-100 of an inch, the remainder to 1-50 of an inch; fourth corner to 1-2 m/m.

NARROW TEMPERED STEEL RULES.

Every Rule is Marked "Tempered."

Metric Measure.

Graduated on one corner of each side only. First corner graduated to 1-2 m/m, second corner to 1 m/m.

No. 175, 10 centimetres. 45c. No. 176, 15 centimetres. 65c.

FLEXIBLE STEEL RULES.

Every Rule is Marked "Tempered."

Metric Measure.

Graduated on one side only. First corner to 1-2 m/m, second corner to 1 m/m.

No. 192, 10 centimetres. 45c. No. 193, 20 centimetres. 85c.

No. 194, 30 centimetres. $1 25 No. 195, 50 centimetres. $2 00

STEEL GEAR RULES.

No. 61. Price, $3 00.

This Rule is 12″ long and has four lines of graduation upon each side, one each, as follows: 18, 20, 22, 24, 26, 28, 30, 32 parts of an inch whole length.

No. 78. Price, $3 00.

This Rule is 12″ long and is graduated 1″ only on each end, as follows: 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38 parts of an inch. The intermediate 10″ are blank, except that the inch lines are made clear across the Rule.

TEMPERED STEEL SHRINK RULES.

English Measure.

Every Rule is Marked "Tempered."

Number.	Shrink per Foot.	Length.	No. of Graduation.	Price.
201	1-8″	12 1-8″	4	$1 75
211	1-8	12 1-8	2	1 75
212	1-8	24 1-4	4	3 50
213	1-8	24 1-4	2	3 50
214	1-8	12 1-8	4	1 75
221	1-8	24 1-4	4	3 50
203	3-16	12 3-16	4	1 75
222	3-16	12 3-16	2	1 75
223	3-16	24 3-8	4	3 50
224	3-16	24 3-8	2	3 50
204	1-4	12 1-4	4	1 75
225	1-4	12 1-4	2	1 75
226	1-4	24 1-2	4	3 50
227	1-4	24 1-2	2	3 50
261	1-8	6 1-16	4	75
262	1-8	6 1-16	2	75
263	1-8	6 1-16	4	75
264	3-16	6 3 32	4	75
265	3-16	6 3-32	2	75
266	1-4	6 1-8	4	75
267	1-8	6 1-8	2	75

Nos. 214, 221, 263, 264, 265, 266 and 267 are graduated as Standard Rules on one side and Shrink Rules on the other. The others are graduated as Shrink Rules on both sides. For Graduations, see page 391.

SQUARE STEEL RULES.

No.	Length.	Number of Graduations.	Price.
230	3"	15, 16 or 17	$ 45
232	4	15, 16 or 17	60
234	6	15, 16 or 17	90

These Rules are divided in parts of inches as follows:

No. 15 Graduation.	No. 16 Graduation.	No. 17 Graduation.
1st cor. 8	16	16
2d cor. 16	32	50
3d cor. 32	64	64
4th cor. 64	100	100

TRIANGULAR STEEL RULES.

No.	Length.	Number of Graduations.	Price.
240	3"	20, 21 or 22	$ 50
242	4	20, 21 or 22	70
244	6	20, 21 or 22	1 00
246	12	20, 21 or 22	2 00

These Rules are divided in parts of inches as follows:

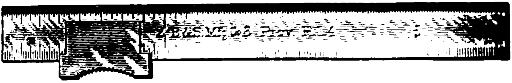
No. 20 Graduation.	No. 21 Graduation.	No. 22 Graduation.
1st cor. 16	16	12, 24, 48
2d cor. 64	32	20, 50, 100
3d cor. 100	64	16, 32, 64

STANDARD STEEL YARD MEASURE.

No. 215. Price, $3 00.

This Measure is 1" wide, 1 8" thick. It is divided into inches and 1-8ths of an inch on one side, and into 1-16, 1-8, 1-4, 3-8, 1-2, 5-8, 3-4 and 7-8 of a yard on the other.

6-INCH RULE WITH SLIDE.



No. 364. Price, $1 00.

This Rule is 6″ long, about 9-16″ wide, 1-16″ thick, and furnished divided into parts of an inch as follows:

No. 1 Graduation.	No. 2 Graduation.
1st cor. 10, 20, 50, 100	8
2nd cor. 12, 24, 48	10, 20, 50, 100
3rd cor. 14, 28	12, 24, 48
4th cor. 16, 32, 64	16, 32, 64

No. 4 Graduation.	No. 7 Graduation.
1st cor. 8	16
2nd cor. 16	32
3rd cor. 32	64
4th cor. 64	100

In ordering, specify which graduation is required.

SLIDE CALIPER RULE.

English or Metric Measure.

No. 365, ENGLISH, Price, $1 25.
No. 367, METRIC, Price, $1 25.

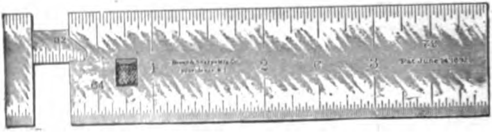
The Slide Caliper Rule, shown in cut, is of steel, about 4 3-16″ long and 1-16″ thick. It is graduated on both corners to 32nds of an inch.

The jaws are 3-8″ deep.

The Metric Rules are graduated to half-millimetres.

STEEL CALIPER RULES.

English or Metric Measure.



No. 360, 3", ...	Price, $2 00.
No. 361, 4", . . .	Price, $2 50.
No. 362, 75 m/m, . .	Price, $2 00.
No. 363, 100 m/m, . .	Price, $2 50.

These Rules are found convenient for use in the stock room or store, in selecting sheet or bar stock, wire, tubing, etc.

They are made in two sizes, 3" or 75 m/m, and 4" or 100 m/m, when closed; and about 1-8" thick. The Slide of the 3" or 75 m/m, can be drawn out to measure 2 1-4", or 50 m/m; and of the 4" or 100 m/m, to measure 3 1-4" or 75 m/m.

The English Rules are divided into Parts of an Inch as follows:

	A	B	C	D
1st cor.	8, 14, 28	8, 14, 28	8	8
2d cor.	12, 24, 48	12, 24, 48	16	16
3d cor.	16, 32, 64	16, 32, 64	32	32
4th cor.	20, 50, 100	20, 50, 100	64	64
Slide,	32 & 64	64 & 100	32 & 64	64 & 100

The Metric Rules are graduated to millimetres and half-millimetres.

BUTTON GAUGE.

No. 394, ... Price, $2 00.

This differs from the Steel Caliper Rule, only in that the outside is graduated to 16ths, 20ths, 32nds and 40ths of an inch and the slide to 40ths and 80ths of an inch.

STANDARD
STEEL STRAIGHT EDGES.

These Straight Edges are made from the best quality of Steel; and every care is taken to insure their being straight.

No.	Length.	Width.	Approximate Thickness.	Price.
370	6"	1"	5-64"	$0 60
372	9	1 1-8	5-64	90
374	12	1 1-4	5-64	1 25
376	18	1 1-2	3-32	2 00
378	24	2	3-32	2 75
380	36	2 1-2	7-64	5 00
382	48	3	7-64	8 00
384	60	3	1-8	12 00
386	72	3	1-8	16 00

BEVELED
STEEL STRAIGHT EDGES.

The beveled edge is 1-16" thick. Only one edge is beveled.

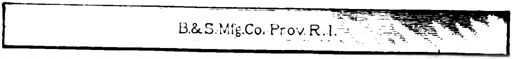
No.	Length.	Width.	Approximate Thickness.	Price.
400	12"	1 3-8"	3-16"	$1 [illegible]
402	18	1 3-4	3-16	[illegible]
404	24	2	1-4	[illegible]
406	36	3	1-4	[illegible]
408	48	3	1-4	[illegible]
410	60	3	1-4	[illegible]
412	72	3 1-8	9-32	[illegible]

HARDENED STEEL STRAIGHT EDGES.

These Straight Edges are like the tongues of the Hardened Steel Try Squares and are hardened on the edges only.

No.	Length.	Width.	Approximate Thickness.	Price.
420	3 7-8″	15-16″	1-16	$0 60
422	5 1-2	1 1-8	5-64	1 00
424	7	1 3-8	5-64	1 25
426	10 3-4	1 3-4	5-64	2 00
428	14	2 1-16	5-64	3 00
430	17	2 7-16	5-64	3 50
432	20	2 7-8	7-64	4 50
434	27	3	7-64	7 00
436	33	3 1-4	1-8	9 00
438	39	3 5-8	1-8	12 00

DRAUGHTSMEN'S STEEL STRAIGHT EDGES.



No.	Length.	Width.	Approximate Thickness.	Price,
450	15″	1 1-4″	3-64″	$0 90
452	18	1 1-2	3-64	1 00
454	24	1 1-2	3-64	1 50
456	30	1 3-4	3-64	2 25
458	36	2	1-16	3 00
460	42	2 1-4	1-16	4 00
462	48	2 1-2	1-16	6 00
464	60	2 3-4	5-64	8 00
465	72	2 3-4	5-64	10 00

TRIANGULAR METALLIC SCALES.

Patented Dec. 16, 1879.

These Patent Triangular Metallic Scales are of the size and shape of the common 12″ Triangular Boxwood Scales. They are made from brass tubing with the ends closed, nickeled with a dull finish and weigh less than 3 1-2 ounces.

The liability of the wood scales to crack, warp or twist, the chipping of their edges and their variation from standard measurement, are well known to all who have used them. These objections we have overcome in the new scales. The ends of these scales are covered with hardened steel plates which slightly raise the scales from the paper

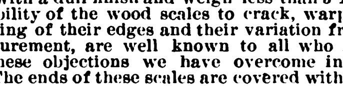
No. 63 M, Price, $2 50. 12″, divided to scales of 1-8, 1-4, 3-8, 1-2, 3-4, 1, 1 1-2, 2, 3 and 4 inches to the foot and 16ths of an inch.

No. 64 M, Price, $2 50. 12″, divided to scales of 3-16, 3-32, 1-8, 1-4, 3-8, 3-4, 1-2, 1, 1 1-2 and 3 inches to the foot and 16ths of inches.

No. 73 M, Price, $2 50. 12″, divided on one edge each to 10ths, 20ths, 30ths, 40ths, 50ths and 60ths of inches; or to 20ths, 30ths, 40ths, 50ths, 60ths, and 80ths of inches

In ordering No. 73 M, state whether the divisions 10 to 60 or 20 to 80 are wanted.

TRIANGULAR BOXWOOD SCALES.



These Scales are Engine Divided.

No. 65, for Architects and Mechanical Draughtsmen.

Nos. 73B and 75, for Railroad Engineers and Land Surveyors.

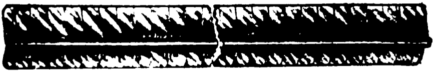
No. 65, $1 50. 6″ Triangular Boxwood Scale, divided to scales of 3-32″, 1-8″, 3-16″, 1-4″, 3-8″, 3-4″, 1-2″, 1″, 1 1-2″ and 3″ to the foot and 16ths of an inch.

No. 73 B, $2 00. 12″ Triangular Boxwood Scale, divided on one edge each to 10ths, 20ths, 30ths, 40ths, 50ths, 60ths of an inch; also divided 20ths, 30ths, 40ths, 50ths, 60ths, 70ths, 80ths.

No. 75, $1 50. 6″ Triangular Boxwood Scale, div[illegible] one edge each to 20ths, 30ths, 40ths, 50ths, 60[illegible] 80ths of an inch.

When ordering Nos. 73B or 75, specify which [illegible] is wanted.

IMPROVED
SCALES FOR DRAUGHTSMEN.



The form of these scales makes them very convenient for many purposes. Those we have in stock are made of steel, nickel plated; a 12″ scale weighs but 2 1-2 oz. Each scale has one kind of graduation, the same on both sides, or two kinds, one on each side. This relieves the draughtsman from the constant care and loss of time required to avoid using the wrong graduation, when there are many kinds on the scale.

List of Scales for Architects.

Price, 6″ scales, $1 00; 12″ scales, $1 25.

One Graduation.

Twelve Inches Long.

No. 275, 3″	= 1 foot.	No. 279, 3-4″	= 1 foot.
No. 276, 2″	= 1 "	No. 280, 1-2″	= 1 "
No. 277, 1 1-2″	= 1 "	No. 281, 1-4″	= 1 "
No. 278, 1″	= 1 "	No. 282, 1-8″	= 1 "

Six Inches Long.

No. 285, 1-2″	= 1 foot.	No. 288, 1-8″	= 1 foot.
No. 286, 1-4″	= 1 "	No. 289, 3-32″	= 1 "
No. 287, 3-16″	= 1 "		

Two Graduations.

Twelve Inches Long.

No. 290, 3″	and 1 1-2″	= 1 foot.	
No. 292, 1″	" 1-2″	= 1 "	
No. 294, 3-4″	" 1 1-2″	= 1 "	
No. 296, 3-8″	" 3-16″	= 1 "	
No. 298, 1-4″	" 1-2″	= 1 "	
No. 300, 1-4″	" 1-8″	= 1 "	
No. 301, 20 cm., 1 mm. & 1-2 mm.			
No. 303, 30 cm., 1 mm. & 1-2 mm.			

SPECIAL SCALES MADE TO ORDER.

Price, 6″ Scales, $2 00; 12″ Scales, $2 50.

[illegible]

SCALES FOR [illegible]

List of Scales for [illegible]

Price, 6" Scales [illegible]

One [illegible]

[illegible]

No. 302, [illegible]
No. 3[illegible]4, [illegible]
No. 306, [illegible]

[illegible]

No. 320, 1-[illegible]
No. 321, 1-[illegible]
No. 322, 1-[illegible]

Two [illegible]

[illegible]

No. [illegible]

[illegible]

No. 340, 12", graduated [illegible]
No. 341, 12", " [illegible]
No. 342, 12", " [illegible]
No. 344, 6", " [illegible]
No. 346, 6", " [illegible]
No. 348, 12", " [illegible]
No. 350, 12", " [illegible] inches), other [illegible]
No. 356, 12", 2"=1 [illegible] figured from the [illegible] an inch, figured [illegible] on each side is divided [illegible]

SPECIAL SCALES MADE [illegible]
Price, 6" Scales, [illegible]

DRAUGHTSMEN'S PROTRACTOR.

About One-Half Size.

This Protractor can be quickly set to any angle. It can be used either side up and on either of the two straight edges and it is of advantage in dividing a circle, transferring angles or laying off a given angle, without resetting, on either side of a line.

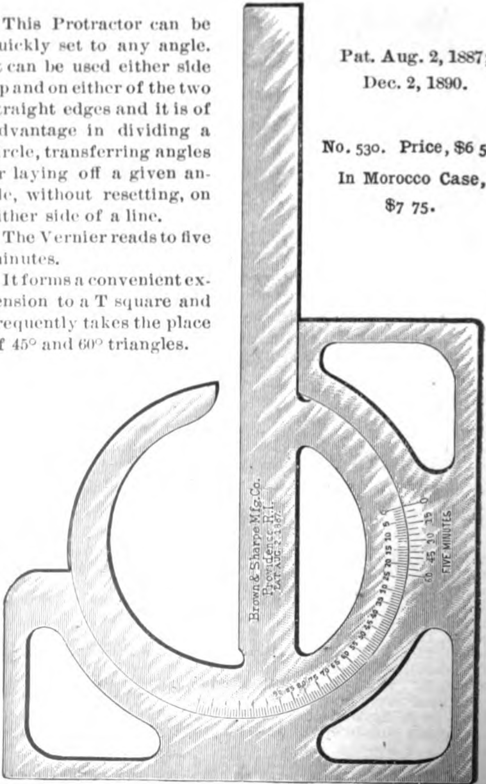
The Vernier reads to five minutes.

It forms a convenient extension to a T square and frequently takes the place of 45° and 60° triangles.

Pat. Aug. 2, 1887;
Dec. 2, 1890.

No. 530. Price, $6 50

In Morocco Case, $7 75.



TABLES FOR USE WITH DRAUGHTSMEN'S PROTRACTORS.

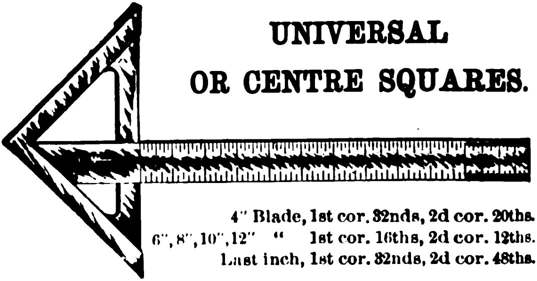
Table for Dividing Circles or Laying out Geometrical Figures.

No. of Sides.	Included Angle.	Angles at Centre of Circles.	Angles for Sides of Figures.
3	120°	30°	30°
4	90°	45°	45°
5	72°	18°—54°	36°—72°
6	60°	30°	30°
8	45°	45°	22° 30′
10	36°	54°—18°	18°—54°
12	30°	60°	15°—45°
14	25° 43′	64° 17′—38° 34′ 12° 51′	12° 51′—38° 34′ 64° 17′
16	22° 30′	67° 30′—45°	11° 15′—33° 45′
18	20°	70°—50°—30° 10°	10°—30°—50° 70°
20	18°	72°—54°	9°—27°—45°
24	15°	75°—60°—45°	7° 30′—22° 30′ 37° 30′

Tapers per Foot and Corresponding Angles.

Taper Per Ft.	Included Angle.	Angle with Centre Line.	Taper Per Ft.	Included Angle.	Angle with Centre Line.
1-8″	0°—36′	0°—18′	1″	4°—46′	2°—23′
1-4″	1°—12′	0°—36′	1½″	7°—09′	3°—35′
5-16″	1°—30′	0°—45′	1¾″	8°—20′	4°—10′
3-8″	1°—47′	0°—54′	2″	9°—31′	[illegible]
7-16″	2°—05′	1°—02′	2½″	[illegible]	[illegible]
1-2″	2°—23′	1°—12′	3″	[illegible]	[illegible]
3-4″	3°—35′	1°—47′	3½″	[illegible]	[illegible]
15-16″	4°—28′	2°—14′	4″	[illegible]	[illegible]

UNIVERSAL OR CENTRE SQUARES.



4" Blade, 1st cor. 32nds, 2d cor. 20ths.
6", 8", 10", 12" " 1st cor. 16ths, 2d cor. 12ths.
Last inch, 1st cor. 32nds, 2d cor. 48ths.

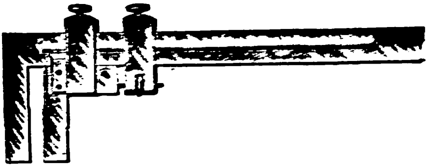
No.	Price.	Length of Blade.	Length of Head.
650	$2 00	4"	3"
652	2 50	6	4
654	3 50	8	5 1-2
656	5 00	10	7
658	6 00	12	8 3-4

OPEN STEEL TRIANGLES

For Draughtsmen.

No.	Angles.	Length of Sides.	Width of Sides.	Price.
540	30°, 60°, 90°	6", 10 3-8", 12"	3-4"	$4 00
542	30°, 60°, 90°	3 1-2", 6 1-16", 7"	5-8	3 00
544	45°, 45°, 90°	8", 8", 11 1-4"	3-4	4 00
546	45°, 45°, 90°	5", 5", 7 1-16"	5-8	3 00

CALIPER SQUARES.



These Caliper Squares are [illegible]

and the other side to [illegible]

They are furnished with and [illegible]

The 4", 6" and 9" Caliper [illegible]

outside measurements.

The 4" Caliper Square is [illegible]

1-2 m/m instead of [illegible]

The 6" and 9" Caliper [illegible]

No.	Price without Adjusting Screw.	Price with Adjusting Screw.	[illegible]	[illegible]	[illegible]
700	$2 25	[illegible]	[illegible]	[illegible]	
702	3 50	[illegible]	[illegible]	[illegible]	[illegible]
704	5 50	[illegible]	[illegible]	[illegible]	
706	9 00	[illegible]	[illegible]	[illegible]	

BOILER PLATE GAUGE.

No. 710. Price, [illegible]

This Gauge is used [illegible]

boat inspectors and [illegible]

It is similar to the 4" [illegible]

long, hardened and [illegible]

somewhat like [illegible]

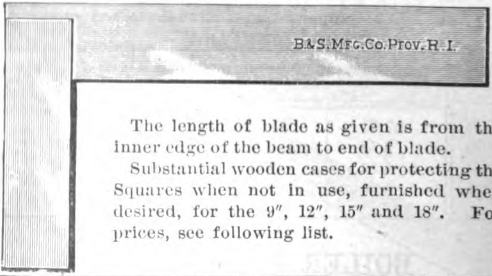
KEY SEAT RULES.

Parallel lines for key seats, mortises, etc., can be readily and accurately drawn with these rules on shafts not less than 7-8" in diameter.

The edges are beveled, and graduated to 32ds of an inch.

No.	Length.	Price.
254	4"	$2 50
256	6	3 00
258	8	3 75

HARDENED CAST STEEL TRY SQUARES.

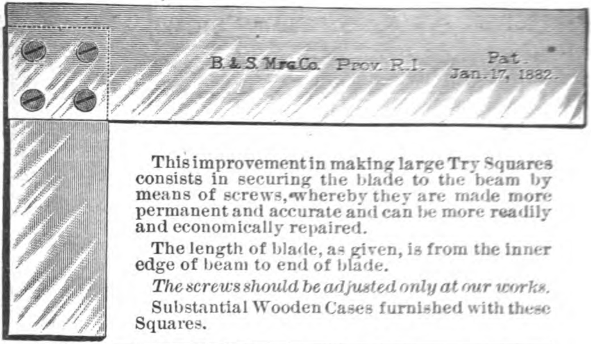


The length of blade as given is from the inner edge of the beam to end of blade.

Substantial wooden cases for protecting the Squares when not in use, furnished when desired, for the 9", 12", 15" and 18". For prices, see following list.

No.	Length of Blade.	Length of Beam.	Price.	Price of Case.
550	1 1-2"	1 9-16"	$1 75	......
552	3	2 7-16	2 50	......
554	4 1-2	3 9-16	3 50	......
555	6	4 3-8	4 50	......
556	9	5 5-8	6 50	$0 50
557	12	7 1-8	9 00	75
558	15	8 3-16	15 00	1 00
560	18	10 1-4	18 00	1 50

IMPROVED HARDENED CAST STEEL TRY SQUARES.



This improvement in making large Try Squares consists in securing the blade to the beam by means of screws, whereby they are made more permanent and accurate and can be more readily and economically repaired.

The length of blade, as given, is from the inner edge of beam to end of blade.

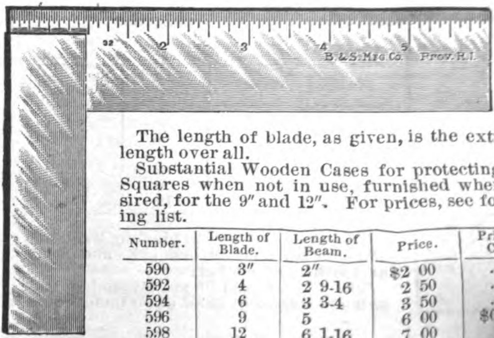
The screws should be adjusted only at our works.

Substantial Wooden Cases furnished with these Squares.

Number.	Length of Blade.	Length of Beam.	Price.
570	24″	13 1-8″	$30 00
572	30	16 1-4	40 00
574	36	19 1-2	50 00

GRADUATED STEEL SQUARES.

NOT HARDENED.



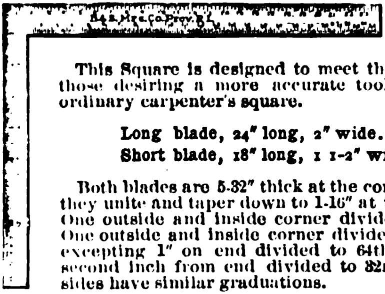
The length of blade, as given, is the extreme length over all.

Substantial Wooden Cases for protecting the Squares when not in use, furnished when desired, for the 9″ and 12″. For prices, see following list.

Number.	Length of Blade.	Length of Beam.	Price.	Price of Case.
590	3″	2″	$2 00	......
592	4	2 9-16	2 50	......
594	6	3 3-4	3 50	......
596	9	5	6 00	$0 50
598	12	6 1-16	7 00	[illegible]

STEEL SQUARES FOR MILLWRIGHTS.

No. 620. Price, $10.00.

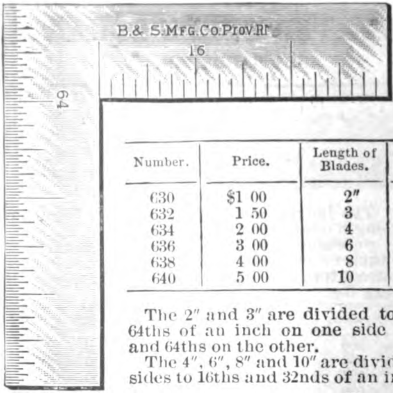


This Square is designed to meet the wants of those desiring a more accurate tool than the ordinary carpenter's square.

Long blade, 24" long, 2" wide.
Short blade, 18" long, 1 1-2" wide.

Both blades are 5-32" thick at the corner where they unite and taper down to 1-16" at their ends. One outside and inside corner divided to 8ths. One outside and inside corner divided to 16ths, excepting 1" on end divided to 64ths and the second inch from end divided to 32nds. Both sides have similar graduations.

THIN STEEL SQUARES.



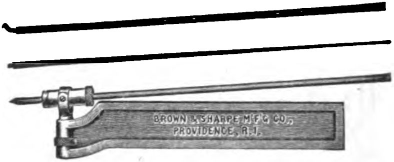
Full Size of a 2 Inch Square.

Number.	Price.	Length of Blades.	Width of Blades.
630	$1 00	2"	1-2"
632	1 50	3	5-8
634	2 00	4	3-4
636	3 00	6	1
638	4 00	8	1 1-8
640	5 00	10	1 1-4

The 2" and 3" are divided to 16ths and 64ths of an inch on one side and 32nds and 64ths on the other.

The 4", 6", 8" and 10" are divided on both sides to 16ths and 32nds of an inch.

LATHE TEST INDICATOR.



No. 467. Price, $3 00.

The Lathe Test Indicator is new in design and is for use in setting centrally, any point or hole in a piece of work to be operated upon in a lathe or upon a face plate. It is also well adapted for testing lathe centres, shafting, or other work held between centres, the inside or outside of cylinders, pulleys, etc., and all work of a similar class.

The tool is made of steel, and is of such a size as to be held conveniently in the tool post of a lathe. The bar, 15-16" wide and 3-8" thick, is drop forged and formed at the end to receive a Universal Joint for supporting the finger holder. The Universal Joint recommends itself by its simplicity of construction. A clamp nut is provided for clamping the joint when it is desired to have only a vertical movement to the finger, as in testing pieces held between centres, the inside or outside of pulleys, etc. The bushing, which holds the finger, is split, thus allowing the finger to be adjusted to lengths required, and clamped in position.

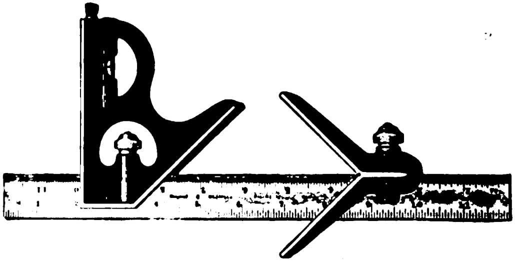
The bar and all wearing parts are hardened.

The finger holder is furnished with two fingers, either one of which can be quickly attached; one finger is ground to an angle of 60° and the other is bent for inside and outside testing.

A spiral spring is provided for holding the finger against the work with an even pressure.

Each tool is neatly packed in a box fitted to receive the various parts.

"B. & S."
COMBINATION SQUARES.
Nos. 30, 35, 40 and 53.



No. 30, With Hardened Heads and Tempered Blades.

No 35, With Hardened Heads and Soft Blades.

No.	Size.	With Centre Head.	No.	Size.	Witho't Centre Head.	No.	Size.	With Centre Head.	No.	Size.	Witho't Centre Head.
			30 H	4"	$1 50				35 H	4"	$1 25
30 B	6"	$2 50	30 K	6	2 00	35 B	6"	$2 25	35 K	6	1 75
30 C	9	2 75	30 O	9	2 25	35 C	9	2 50	35 O	9	2 00
30 D	12	3 00	30 P	12	2 50	35 D	12	2 75	35 P	12	2 25
30 E	18	3 75	30 R	18	3 25	35 E	18	3 50	35 R	18	3 00
30 F	24	4 25	30 S	24	3 75	35 F	24	4 00	35 S	24	3 50

No. 40, With Soft Heads and Tempered Blades.

No. 53, With Soft Heads and Soft Blades.

No.	Size.	With Centre Head.	No.	Size.	Witho't Centre Head.	No.	Size.	With Centre Head.	No.	Size.	Witho't Centre Head.
			40 H	4"	$1 25				53 H	4"	$1 00
40 B	6"	$2 00	40 K	6	1 50	53 B	6"	$1 75	53 K	6	1 25
40 C	9	2 25	40 O	9	1 75	53 C	9	2 00	53 O	9	1 50
40 D	12	2 50	40 P	12	2 00	53 D	12	2 25	53 P	12	1 75
40 E	18	3 25	40 R	18	2 75	53 E	18	3 00	53 R	18	2 50
40 F	24	3 75	40 S	24	3 25	53 F	24	3 50	53 S	24	3 00

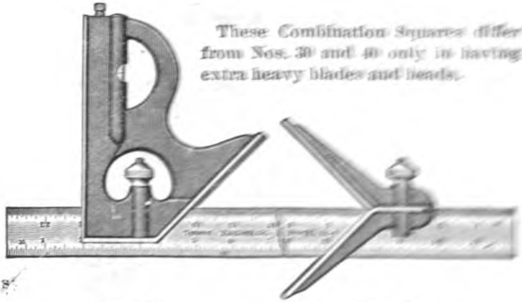
The blades are divided into parts of inches, as follows:

	No. 1 Grad.	No. 2 Grad.	No. 4 Grad.	No. 7 Grad.
1st corner,	10, 20, 50, 100	8	8	16
2d corner,	12. 24, 48	10, 20, 50, 100	16	32
3d corner,	14, 28	12, 24, 48	32	64
4th corner,	16, 32, 64	16, 32, 64	64	100

"B. & S."

COMBINATION SQUARES.

Nos. 50 and 61.



These Combination Squares differ from Nos. 30 and 40 only in having extra heavy blades and heads.

No. 50, With Hardened Heads and Tempered Blades.						No. 61, With Soft Heads and Tempered Blades.					
No.	Size.	With Centre Head.	No.	Size.	Without Centre Head.	No.	Size.	With Centre Head.	No.	Size.	Without Centre Head.
50E	18"	$4 75	50R	18"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50F	24	5 50	50S	24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Separate Parts for Combination Squares.

ENGLISH OR METRIC [illegible]

Size.	[illegible]	[illegible]	[illegible]	[illegible]
4" or 10 c/m	[illegible]	[illegible]	[illegible]	[illegible]
6" or 15 c/m	[illegible]	[illegible]	[illegible]	[illegible]
9" or 20 c/m	1 [illegible]	[illegible]	[illegible]	[illegible]
12" or 30 c/m	1 [illegible]	[illegible]	[illegible]	[illegible]
18" or 50 c/m	2 [illegible]	2 [illegible]	[illegible]	[illegible]
24" or 60 c/m	2 [illegible]	2 [illegible]	[illegible]	[illegible]
Heavy 18" or 50 c/m		2 [illegible]	[illegible]	[illegible]
Heavy 24" or 60 c/m		[illegible]	[illegible]	[illegible]

Scribers . . [illegible]

Level Glasses [illegible]

"B. & S."

COMBINATION SQUARES.

Metric Measure.

No. M30,
With Hardened Heads and Tempered Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
			M30H	10	$1 50
M30B	15	$2 50	M30K	15	2 00
M30C	20	2 75	M30O	20	2 25
M30D	30	3 00	M30P	30	2 50
M30E	50	3 75	M30R	50	3 25
M30F	60	4 25	M30 S	60	3 75

No. M35,
With Hardened Heads and Soft Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
			M35H	10	$1 25
M35B	15	$2 25	M35K	15	1 75
M35C	20	2 50	M35O	20	2 00
M35D	30	2 75	M35P	30	2 25
M35E	50	3 50	M35R	50	3 00
M35F	60	4 00	M35 S	60	3 50

No M40,
With Soft Heads and Tempered Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
			M40H	10	$1 25
M40B	15	$2 00	M40K	15	1 50
M40C	20	2 25	M40O	20	1 75
M40D	30	2 50	M40P	30	2 00
M40E	50	3 25	M40R	50	2 75
M40F	60	3 75	M40 S	60	3 25

No. M53,
With Soft Heads and Soft Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
			M53H	10	$1 00
M53B	15	$1 75	M53K	15	1 25
M53C	20	2 00	M53O	20	1 50
M53D	30	2 25	M53P	30	1 75
M53E	50	3 00	M53R	50	2 50
M53F	60	3 50	M53 S	60	3 00

No. M50,
With Hardened Heads and Tempered Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
M50E	50	$4 75	M50R	50	$3 00
M50F	60	5 50	M50 S	60	3 75

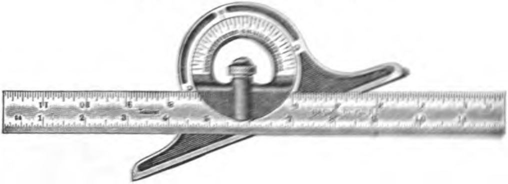
No. M61,
With Soft Heads and Tempered Blades.

No.	Size in cm.	With Cntre Head.	No.	Size in cm.	Without Cntre Head.
M61E	50	$4 00	M61R	50	$2 75
M61F	60	4 75	M61 S	60	3 50

The blades are furnished graduated as follows: 1st and 3d corners to millimetres; 2d and 4th corners to 1-2 millimetres.

"B. & S." PROTRACTORS.

Nos. 20, 21 and 22.



These Protractors are made with the same care and attention to detail as is shown in the line of Combination Squares. The revolving turret that carries the blade is fitted to a nicety and accurately graduated, being engine divided to 90° either side of zero, and every care is taken to insure the zero being at right angles to the face of the head. It can be set at any angle and rigidly clamped by a thumb nut. The blade, furnished either soft or tempered, is clamped in the same manner as the blades of Combination Squares. The level, which is so important an adjunct to a tool of this kind, is accurately set and fastened to the side of the turret. It is included in the price of the tool.

No. 20,
With Soft Blades.

No.	Size.	Price.
20 C	9"	$2 75
20 D	12	3 00

No. 21,
With Tempered Blades

No.	Size.	Price.
21 C	9"	$3 00
21 D	12	3 [illegible]

Price, Protractor Head with Level, $2 00.

No. 22,
With Tempered Blades.

No.	Size.	Price.
22 E	18"	$5 00
22 F	24	5 [illegible]

This Protractor differs from No. 21 only in having extra heavy blades and heavy heads. The heads are about 9" long and 1-2" wide.

Price, Heavy Protractor Head with Level, $2 50.

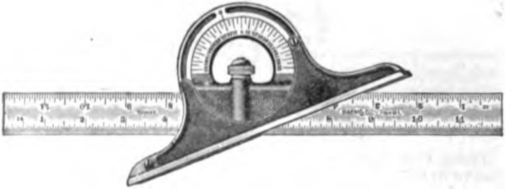
The blades are divided into parts of an inch, as follows:

	No. 1 Grad.	No. 2 Grad.	No. 4 Grad.	No. 7 Grad.
1st corner,	10, 20, 50, 100	8	8	16
2d corner,	12, 24, 48	10, 20, 50, 100	16	[illegible]
3d corner,	14, 28	12, 24, 48	32	[illegible]
4th corner,	16, 32, 64	16, 32, 64	64	[illegible]

"B. & S." PROTRACTORS.

Nos. 24, 25 and 26.

WITH REVERSIBLE HEADS.



These Protractors are the same in design as the Nos. 20 and 21, excepting that the face of the head is wider and projects beyond each side of the blade. This is an important feature and adds greatly to the utility of the tool. Either side of the tool can be used in transferring angles, thus avoiding the necessity of re-setting. The heads are the same length as those for the Nos. 20 and 21 and are about 1" wide.

No. 24, With Soft Blades. **No. 25,** With Tempered Blades.

No.	Size.	Price.	No.	Size.	Price.
24 C	9"	$3 25	25 C	9"	$3 50
24 D	12	3 50	25 D	12	3 75

Price, Protractor Head with Level, $2 50.

No. 26,
With Tempered Blades.

No.	Size.	Price.
26 E	18"	$5 50
26 F	24	6 25

These Protractors differ from No. 25 only in having extra heavy blades and heavy Reversible Heads about 9" long and 1" thick.

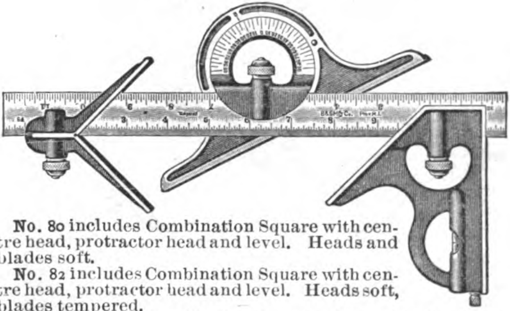
Price, Heavy Protractor Head with Level, $3 00.

The blades are divided into parts of an inch, as follows:

	No. 1 Grad.	No. 2 Grad.	No. 4 Grad.	No. 7 Grad.
1st corner,	10, 20, 50, 100	8	8	16
2d corner,	12, 24, 48	10, 20, 50, 100	16	32
3d corner,	14, 28	12, 24, 48	32	64
4th corner,	16, 32, 64	16, 32, 64	64	100

"B. & S." COMBINATION SETS.

Nos. 80, 82, 84, 85 and 87.



No. 80 includes Combination Square with centre head, protractor head and level. Heads and blades soft.

No. 82 includes Combination Square with centre head, protractor head and level. Heads soft, blades tempered.

No. 85 includes Combination Square with centre head, protractor head and level. Sq. heads hardened, blades tempered.

No. 80, With Soft Heads and Soft Blades.			No. 82, With Soft Heads and Tempered Blades.			No. 85, With Sq. Heads Hardened and Tempered Blades		
No.	Size.	Price.	No.	Size.	Price.	No.	Size.	Price.
80 C	9″	$4 00	82 C	9″	$4 25	85 C	9″	$4 75
80 D	12	4 25	82 D	12	4 50	85 D	12	5 00
80 E	18	5 00	82 E	18	5 25	85 E	18	5 75
80 F	24	5 50	82 F	24	5 75	85 F	24	6 25

No. 84, With Soft Heads and Tempered Blades.			No. 87, With Square Heads Hardened and Tempered Blades.		
No.	Size.	Price.	No.	Size.	Price.
84E	18″	$6 50	87E	18″	$7 25
84F	24	7 25	87F	24	8 00

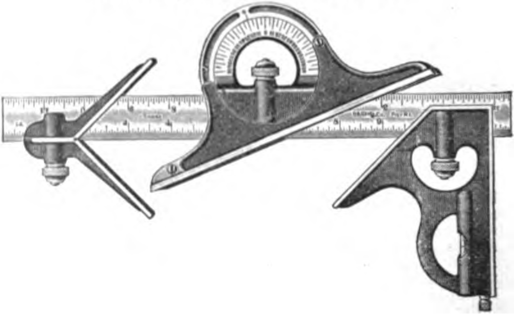
Nos. 84 and 87 differ from Nos. 82 and 85 only in having extra heavy blades, the Square Heads the same as those on Combination Squares Nos. 50 and 61 and the Protractor Heads 9″ long and 1-2″ thick.

The blades are divided into parts of an inch, as follows:

	No. 1 Grad.	No. 2 Grad.	No. 4 Grad.	No. 7 Grad.
1st corner,	10, 20, 50, 100	8	8	16
2d corner,	12, 24, 48	10, 20, 50, 100	16	32
3d corner,	14, 28	12, 24, 48	32	64
4th corner,	16, 32, 64	16, 32, 64	64	100

"B. & S." COMBINATION SETS.

Nos. 90, 92, 94, 95 and 97.



These Sets differ from Nos. 80, 82, 84, 85 and 87 only in having the Reversible Protractor Head, described on page 420.

No. 90, With Soft Heads and Soft Blades.			No. 92, With Soft Heads and Tempered Blades.			No. 95, With Sq. Heads Hardened and Tempered Blades.		
No.	Size.	Price.	No.	Size.	Price.	No.	Size.	Price.
90 C	9″	$4 50	92 C.	9″	$4 75	95 C	9″	$5 25
90 D	12	4 75	92 D	12	5 00	95 D	12	5 50
90 E	18	5 50	92 E	18	5 75	95 E	18	6 25
90 F	24	6 00	92 F	24	6 25	95 F	24	6 75

No. 94, With Soft Heads and Tempered Blaces.			No. 97. With Square Heads Hardened and Tempered Blades.		
No.	Size.	Price.	No.	Size.	Price.
94 E	18″	$7 00	97 E	18″	$7 75
94 F	24	7 75	97 F	24	8 50

Nos. 94 and 97 differ from Nos. 92 and 95 only in having extra heavy blades, the square heads like those on the Combination Squares Nos. 50 and 61, and the Protractor Head about 9″ long and 1-2″ thick.

The blades are divided into parts of an inch, as follows:

	No. 1 Grad.	No. 2 Grad.	No. 4 Grad.	No. 7 Grad.
1st corner,	10, 20, 50, 100	8	8	16
2d corner,	12, 24, 48	10, 20, 50, 100	16	32
3d corner,	14, 28	12, 24, 48	32	64
4th corner,	16, 32, 64	16, 32, 64	64	100

"B. & S." PROTRACTORS.

METRIC MEASURE.

No. M20, With Soft Blades.			No. M21. With Tempered Blades.			[illegible]		
No.	Size in cm.	Price.	No.	Size in cm.	Price.	[illegible]	[illegible]	[illegible]
M20C	20	$2 75	M21C	20	[illegible]	[illegible]	[illegible]	[illegible]
M20D	30	3 00	M21D	30	3 25	[illegible]	[illegible]	[illegible]

WITH REVERSIBLE [illegible]

No. M24. With Soft Blades.			No. M25. [illegible]			[illegible]		
No.	Size in cm.	Price.	No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M24C	20	$3 25	M25C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M24D	30	3 50	M25D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

"B. & S." COMBINATION SETS.

[illegible]

No. M80. With Soft Heads and Soft Blades.			[illegible]			[illegible]		
No.	Size in cm.	Price.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M80C	20	$4 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M80D	30	4 25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M80E	50	5 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M80F	60	5 50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

No. M84. With Soft Heads and Tempered Blades.			[illegible]		
No.	Size in cm.	[illegible]	[illegible]	[illegible]	[illegible]
M84E	50	[illegible]	[illegible]	[illegible]	[illegible]
M84F	60	[illegible]	[illegible]	[illegible]	[illegible]

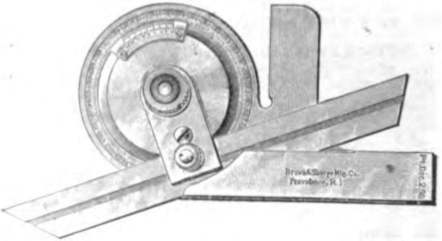
WITH [illegible]

No. M90. With Soft Heads and Soft Blades.			[illegible]			[illegible]		
No.	Size in cm.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M90C	20	$4 50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M90D	30	4 75	M92D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M90E	50	5 50	M92E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M90F	60	6 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

No. M94. With Soft Heads and Tempered Blades.			[illegible]		
No.	Size in cm.	[illegible]	[illegible]	[illegible]	[illegible]
M94E	50	[illegible]	[illegible]	[illegible]	[illegible]
M94F	60	[illegible]	[illegible]	[illegible]	[illegible]

The blades of the [illegible] Sets are furnished [illegible] to millimetres, 2d and [illegible]

IMPROVED
UNIVERSAL BEVEL PROTRACTOR.



No. 495. Protractor with 6″ blade, Price, $8 00.
In Morocco Case, $9 00.

No. 496. Protractor with 12″ blade, Price, $9 00.
In Morocco Case, $10 50.

EXTRA BLADES. 6″, Price, $0 75; 12″, Price, $1 75.

This Protractor is well adapted for all classes of work where angles are to be laid out or established. Its uses as a Protractor are practically unlimited; the cuts on opposite page explain themselves and show a few of its many applications.

One side of the stock is flat, thus permitting its being laid flat upon the paper or work.

The dial is accurately graduated in degrees the entire circle. It turns on a large central stud, which is hardened and ground and can be rigidly clamped by a thumb nut.

The line of graduations is below the surface, protecting them from wear.

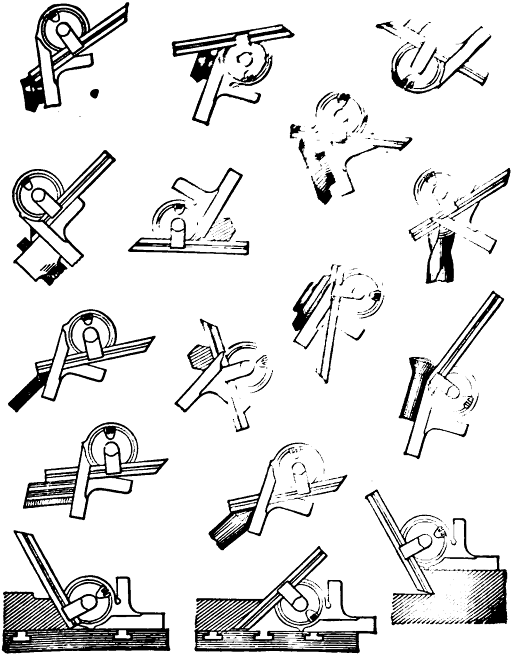
The Vernier adds materially to the use of the Protractor in obtaining fine measurements. It reads to 5 minutes or 1-12 of a degree.

The blade is about 1-16″ thick, can be moved back and forth its entire length and clamped independently of the dial, thus adapting this Protractor for work where others cannot be used.

APPLICATIONS

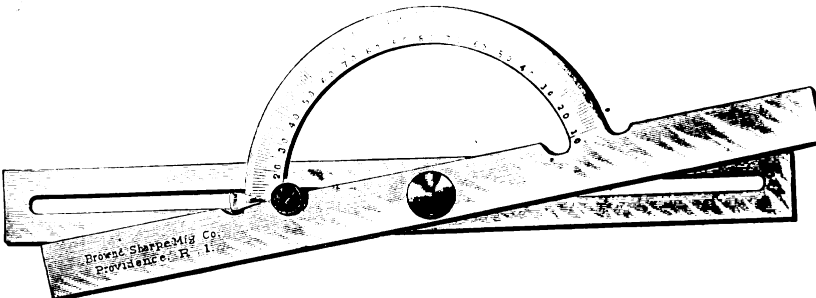
OF THE

IMPROVED UNIVERSAL BEVEL PROTRACTOR.



Special Circular on Application.

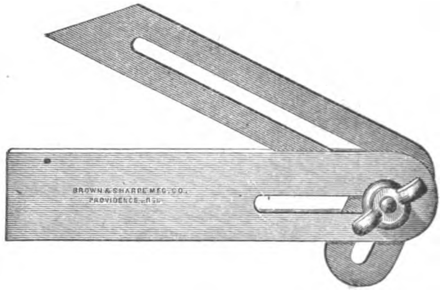
BEVEL PROTRACTORS.



The half-circle is divided into degrees.

Number.	Length of Sliding Arm.	Price.
490	6″	$4 50
492	10	5 75

IMPROVED UNIVERSAL BEVEL.

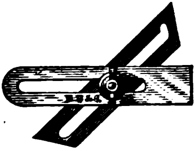


No. 483. Price, $1 50.

The above cut represents an improved Universal Bevel, 3″ long, with an offset blade that admits of the measurement of all angles.

The case is solid on the top for 1 1-2″ from the square end.

UNIVERSAL BEVELS.

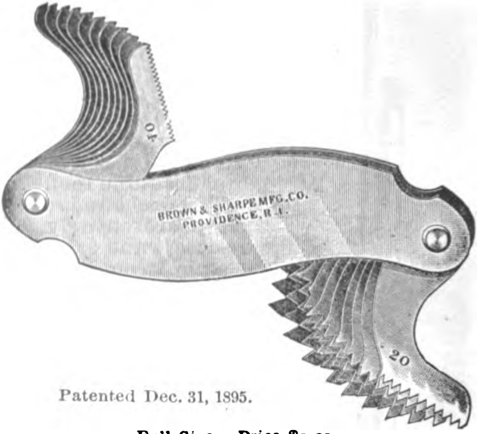


No.	Price.	Length of Head and Tongue.	Width of Head and Tongue.
480	$1 25	3″	5-8″
482	1 25	1 1-4	1-4

No. 20 SCREW PITCH GAUGE.

22 PITCHES,

Including Pipe Thread Pitches.



Patented Dec. 31, 1895.

Full Size. Price $1 00.

This Screw Pitch Gauge will measure the threads of nuts as well as of screws, and contains the pitches 9, 10, 11, 11½, 12, 13, 14, 15, 16, 18, 20, on one end, and 22, 24, 26, 27, 28, 30, 32, 34, 36, 38 and 40, on the other end.

The arrangement of blades hinged on each end of the case enables any desired number to be quickly placed in position for use.

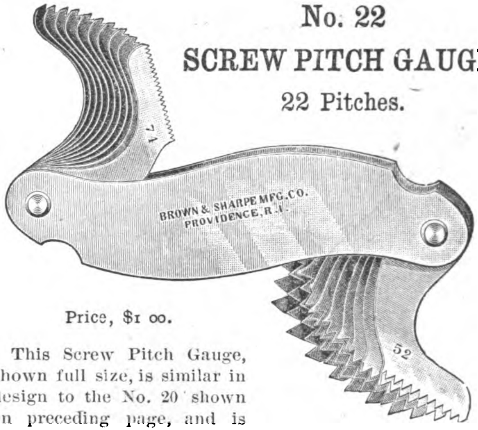
We call attention to the following facts:

There are 22 pitches, including pipe thread pitches, 11½ and 27. The 8 pitch can be determined by using the 16 pitch blade.

The 11 smaller pitches are on blades made narrower than the 11 larger ones, so that they have a wider range of use in measuring the threads of nuts than would be the case were they all of a size.

The gauge numbers are stamped on the outside of the frame, as well as on both sides of each blade, allowing the user to determine the position of a desired number at a glance.

No. 22
SCREW PITCH GAUGE.
22 Pitches.



Price, $1 00.

This Screw Pitch Gauge, shown full size, is similar in design to the No. 20 shown on preceding page, and is designed especially to meet the requirements of bicycle manufacturers, electricians and others using screws with fine V threads.

The Gauge contains 22 blades with pitches 32, 34, 36, 38, 40, 42, 44, 46, 48, 50 and 52 on one end and 54, 56, 58, 60, 62, 64, 66, 68, 70, 72 and 74 on the other.

SCREW PITCH GAUGE.
25 Pitches.
U. S. Standard Thread.

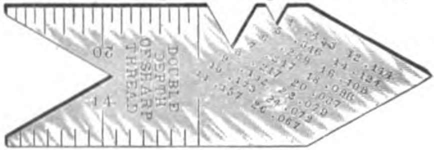
No. 766. Price, $1 50.

This Screw Pitch Gauge is the same in design as No. 22.

It contains 26 blades with pitches 2 1-4, 2 3-8, 2 1-2, 2 5-8, 2 3-4, 2 7-8, 3, 3 1-4, 3 1-2, 4, 4 1-2 and 5 on one end, and 5 1-2, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18 and 20 on the other. It also contains a blade with a gauge for grinding Thread Tools.

CENTRE GAUGES

And Gauges for Grinding and Setting Screw Cutting Tools.



Full Size.

With Table for dertermining the size of Tap Drills for 60° V Threads.

U. S. Standard, 60°.

No. 510, Price, 25 Cents. No. 511, Tempered, Price, 35 Cents.

Whitworth or English Standard, 55°.

No. 512, Price, 25 Cents. No. 513, Tempered, Price, 35 Cents.

Metric, 60°.

No. 508, Price, 25 Cents. No. 509, Tempered, Price, 35 Cents.

The angles used on these gauges are 60 degrees for the U. S. Standard and Metric Gauges, and 55 degrees for the Whitworth or English Standard. The four divisions 14, 20, 24 and 32 parts to the inch are useful in measuring the number of threads to the inch. The following parts to the inch can be determined by them, viz.: 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, 28 and 32.

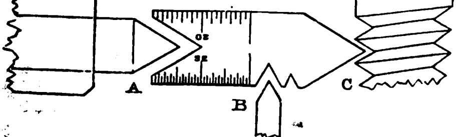
The metric guage is graduated to read to millimetres and half millimetres. When so graduated the table for determining the size of tap drills is omitted.

The table on the gauge (see full size cut) is used for determining the size of tap drills for sharp 60° V threads, and shows in thousandths of an inch the double depth of thread of tap and screws of the pitches most commonly used. This table is made up by dividing 1.732, the double depth of thread of a screw that is one pitch, by the number of threads of the various pitches shown. For instance, the decimal .433, representing the double depth of thread of a screw that is four pitch, is obtained by dividing 1.732 by 4. In the same manner the double depth of thread of pitches not shown in the table may be readily obtained. The double depth of thread of a screw that is two pitch, for instance, is one-half of 1.732.

As the double depth of thread represents the difference in the diameter of a tap and a tap drill, to obtain the diameter of a tap drill of any desired pitch it is only necessary to substract the decimal showing the double depth of thread of that pitch from the diameter of the tap. For example, if the tap is four pitch, sharp V thread, and one inch diameter, subtract .433, the decimal showing the double depth of thread of this pitch in the table, from one, and the result, .567 of an inch, is the size of the tap drill, which would allow a sharp thread in the hole. Allowance is to be made for the extent to which it is desired the threads should be flattened.

METHODS OF USING CENTRE GAUGE.

Fig. 1



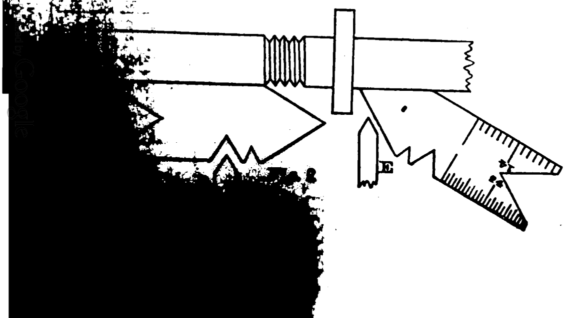
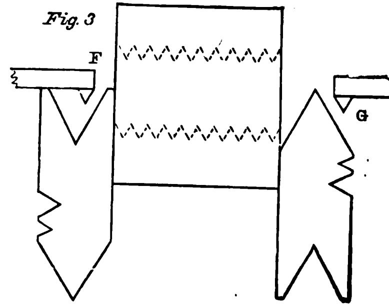


Fig. 3



U. S. STANDARD SCREW THREADS.

Diameter of Screw.	Threads per Inch.	Diameter at Root of Thread.	Width of Flat.
			
1-4	20	.185	.0063
5-16	18	.2403	.0069
3-8	16	.2936	.0078
7-16	14	.3447	.0089
1-2	13	.4001	.0096
9-16	12	.4542	.0104
5-8	11	.5069	.0114
3-4	10	.6201	.0125
7-8	9	.7307	.0139
1	8	.8376	.0156
1 1-8	7	.9394	.0179
1 1-4	7	1.0644	.0179
1 3-8	6	1.1585	.0208
1 1-2	6	1.2835	.0208
1 5-8	5 1-2	1.3888	.0227
1 3-4	5	1.4902	.0250
1 7-8	5	1.6152	.0250
2	4 1-2	1.7113	.0278
2 1-4	4 1-2	1.9613	.0278
2 1-2	4	2.1752	.0313
2 3-4	4	2.4252	.0313
3	3 1-2	2.6288	.0357
3 1-4	3 1-2	2.8788	.0357
3 1-2	3 1-4	3.1003	.0385
3 3-4	3	3.3170	.0417
4	3	3.5670	.0417
4 1-4	2 7-8	3.7982	.0435
4 1-2	2 3-4	4.0276	.0455
4 3-4	2 5-8	4.2551	.0476
5	2 1-2	4.4804	.0500
5 1-4	2 1-2	4.7304	.0500
5 1-2	2 3-8	4.9530	.0526
5 3-4	2 3-8	5.2030	.0526
6	2 1-4	5.4226	.0556

STANDARD SCREW THREAD GAUGE

No. 825. Price, [illegible]

This Gauge is to be used [illegible] to cut threads according to [illegible] The angles are 60 degrees [illegible] bottom of threads are [illegible]

DEPTH OF GEAR TOOTH GAUGE

Price, [illegible]

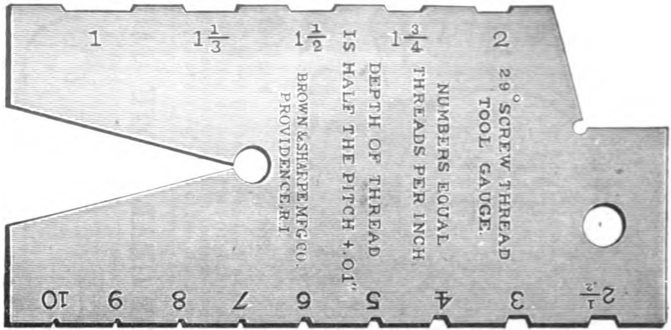
Price, Sizes to 3 Pitch, [illegible]

Larger [illegible]

Depth of Gear Tooth Gauges for all [illegible] 3 to 48 pitch inclusive, [illegible] answers for each pitch and [illegible] to be cut.

IMPROVED 29° SCREW THREAD TOOL GAUGE.

"ACME STANDARD."



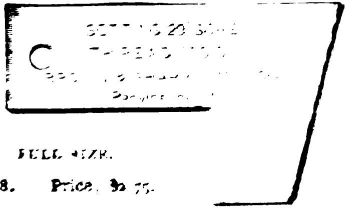
No. 829.   Price, $2 50.

This Gauge furnishes a correct standard to which tools can be ground to cut threads, of a uniform angle, to take the place of square threads.

This Gauge is made of the best steel, tempered, adjusted, and all angles accurately tested after hardening.

29° SCREW THREAD TOOL GAUGE.

"ACME STANDARD."



FULL SIZE.

No. 828. Price, $2.75.

This Gauge is for the [illegible] **standard** to [illegible] **uniform** angle [illegible] **standardize** [illegible] **in use.** This [illegible] **than the** square thread. [illegible] 14 1-2°, or 29° included [illegible] now generally adopted [illegible]

A tool [illegible] price of each gauge.

AMERICAN STANDARD WIRE GAUGE.

ADOPTED BY THE BRASS MANUFACTURERS, JAN. 1858.

These Gauges are made from the best steel, and are tempered, adjusted, and warranted accurate.

☞ None genuine unless stamped as in the engraving with our trade marks.

No. 730, sizes 0 to 36,	. . .	$2 50
No. 732, sizes 5 to 36,	. . .	2 00

In order to familiarize the users of the gauge with the decimal equivalents of the gauge numbers, we furnish No. 732 with these decimal equivalents expressed in thousandths, stamped on the back, opposite to the regular gauge numbers.

ENGLISH STANDARD WIRE GAUGE.

THE SAME AS STUBS' WIRE, OR BIRMINGHAM GAUGE.

No. 734, 1 to 36, $2 00. **No. 736, 6 to 36, $1 90.**

Sizes of the Numbers of English Standard Wire Gauge.

No. of Wire Gauge.	Size of each No. in Decimal Parts of an Inch.	No. of Wire Gauge.	Size of each No. in Decimal Parts of an Inch.	No. of Wire Gauge.	Size of each No. in Decimal Parts of an Inch.
0000	.454	11	.120	25	.020
000	.425	12	.109	26	.018
00	.380	13	.095	27	.016
0	.340	14	.083	28	.014
1	.300	15	.072	29	.013
2	.284	16	.065	30	.012
3	.259	17	.058	31	.010
4	.238	18	.049	32	.009
5	.220	19	.042	33	.008
6	.203	20	.035	34	.007
7	.180	21	.032	35	.005
8	.165	22	.028	36	.004
9	.148	23	.025		
10	.134	24	.022		

WASHBURN & MOEN STANDARD
WIRE GAUGE.

No. 737, Sizes 0 to 36, Price, $2 50.

This Gauge is 3 1-4″ in diameter, and about 1-8″ thick. It is made from the best steel, tempered, adjusted, and all sizes tested after hardening.

The Gauge numbers, which run from 0 to 36, are those of the Washburn & Moen Standard Wire Gauge.

No. of Wire Gauge.	Size of each No. in Decimal Parts of an inch.	No. of Wire Gauge.	Size of each No. in Decimal Parts of an inch.	No. of Wire Gauge.	Size of each No. in Decimal Parts of an inch.
0000	.3938	11	.1205	24	.0230
000	.3625	12	.1055	25	.0204
00	.3310	13	.0915	26	.0181
0	.3065	14	.0800	27	.0173
1	.2830	15	.0720	28	.0162
2	.2625	16	.0625	29	.0150
3	.2437	17	.0540	30	.0140
4	.2253	18	.0475	31	.0132
5	.2070	19	.0410	32	.0128
6	.1920	20	.0348	33	.0118
7	.1770	21	.03175	34	.0104
8	.1620	22	.0286	35	.0095
9	.1483	23	.0258	36	.0090
10	.1350				

STEEL MUSIC WIRE GAUGE

WASHBURN & MOEN STANDARD

Full Size

No. 73[illegible]　　[illegible]

Sizes of the Numbers of Steel Music Wire Gauge

No. of Gauge	[illegible]	[illegible]	[illegible]
8-0	[illegible]	[illegible]	[illegible]
7-0	[illegible]	[illegible]	[illegible]
6-0	[illegible]	[illegible]	[illegible]
5-0	[illegible]	[illegible]	[illegible]
4-0	[illegible]	[illegible]	[illegible]
3-0	[illegible]	[illegible]	[illegible]
2-0	[illegible]	[illegible]	[illegible]
1-0	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]

U. S. STANDARD GAUGE.

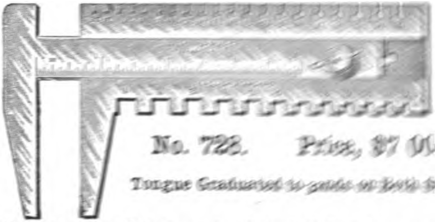
No. 740. Price, $2 50.

This Gauge is 3 1-4″ in diameter and about 1-8″ thick. The Gauge numbers, which run from 0 to 36, are those of the U. S. Standard Gauge for Sheet and Plate Iron and Steel, adopted by Congress, March 3, 1893.

The Gauge is hardened and tempered, and all sizes are carefully tested after hardening.

WIRE GAUGE AND CALIPER.

[illegible] OR [illegible] STANDARD.



No. 728. Price, $7 00.

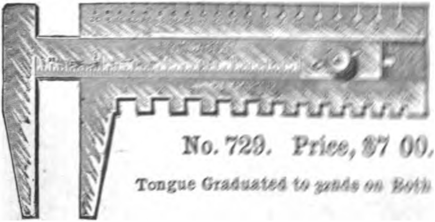
Tongue Graduated to [illegible] on Both Sides.

This Gauge and Caliper is of steel, 5 3/4" long and [illegible] 3-16" thick. The [illegible]. The tongue is graduated on both sides to [illegible] measure 4". The gauge numbers are [illegible] of the English or Birmingham Standard [illegible].

The tool is found [illegible] purposes in [illegible] Iron and Steel [illegible]. The Caliper [illegible] sizes of stock.

WIRE GAUGE AND CALIPER.

U. S. STANDARD. Sheet and Plate Iron and Steel.



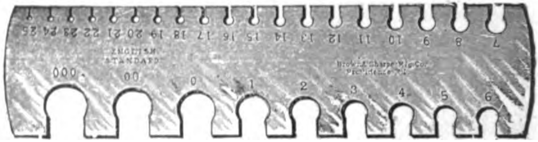
No. 729. Price, $7 00.

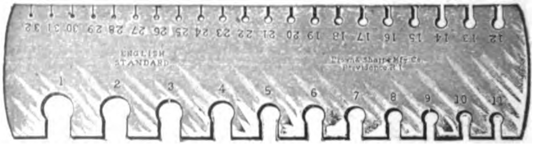
Tongue Graduated to [illegible] on Both Sides.

This Gauge and Caliper is similar in general design to that shown and described above, with the exception that the gauge numbers, which run from 1 to 32, are those of the U. S. Standard Sheet and Plate Iron and Steel, adopted by Congress, March 3rd, 1893.

ROLLING MILL GAUGES.

English or Birmingham Standard.





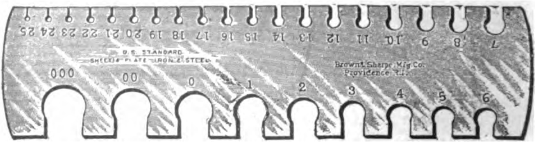
No. 744, sizes 000 to 25, ... $2 50
No. 746, " 1 to 32, ... $3 00

These gauges are shown about one-third size in cut. They are made of steel, hardened and tempered. They are about 3-16ths of an inch thick and are well adapted to the rough usage they are likely to have in rolling mills or in other places where many measurements are to be quickly taken.

ROLLING MILL GAUGE.

U. S. Standard Gauge for Sheet and Plate Iron and Steel.

Adopted by Congress, March 3, 1893.



No. 747, Sizes 000 to 25. Price, $2 50.

SIZES OF NUMBERS OF THE U. S. STANDARD GAUGE

For Sheet and Plate Iron and Steel.

An Act Establishing a Standard Gauge for Sheet and Plate Iron and Steel.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled: That for the purpose of securing uniformity the following is established as the only gauge for sheet and plate iron and steel in the United States of America, namely:

Numbea of Gauge.	Approximate Thickness in Fractions of an Inch.	Approximate Thickness in Decimal Parts of an Inch.	Weight per Square Foot in Ounces Avoirdupois.	Weight per Square Foot in Pounds Avoirdupois.
0000000	1-2	:5	320	20.00
000000	15-32	.46875	300	18.75
00000	7-16	.4375	280	17.50
0000	13-32	.40625	260	16.25
000	3-8	.375	240	15.
00	11-32	.34375	220	13.75
0	5-16	.3125	200	12.50
1	9-32	.28125	180	11.25
2	17-64	.265625	170	10.625
3	1-4	.25	160	10.
4	15-64	.234375	150	9.375
5	7-32	.21875	140	8.75
6	13-64	.203125	130	8.125
7	3-16	.1875	120	7.5
8	11-64	.171875	110	6.875
9	5-32	.15625	100	6.25
10	9-64	.140625	90	5.625
11	1-8	.125	80	5.
12	7-64	.109375	70	4.375
13	3-32	.09375	60	3.75
14	5-64	.078125	50	3.125
15	9-128	.0703125	45	2.8125

Number of Gauge.	Approximate Thickness in Fractions of an Inch.	Approximate Thickness in Decimal Parts of an Inch.	Weight Per Square Foot in Ounces Avoirdupois.	Weight Per Square Foot in Pounds Avoirdupois.
16	1-16	.0625	40	2.5
17	9-160	.05625	36	2.25
18	1-20	.05	32	2.
19	7-160	.04375	28	1.75
20	3-80	.0375	24	1.50
21	11-320	.034375	22	1.375
22	1-32	.03125	20	1.25
23	9-320	.028125	18	1.125
24	1-40	.025	16	1.
25	7-320	.021875	14	.875
26	3-160	.01875	12	.75
27	11-640	.0171875	11	.6875
28	1-64	.015625	10	.625
29	9-640	.0140625	9	.5625
30	1-80	.0125	8	.5
31	7-640	.0109375	7	.4375
32	13-1280	.01015625	6 1-2	.40625
33	3-320	.009375	6	.375
34	11-1280	.00859375	5 1-2	.34375
35	5-640	.0078125	5	.3125
36	9-1280	.00703125	4 1-2	.28125
37	17-2560	.006640625	4 1-4	.265625
38	1-160	.00625	4	.25

And on and after July first, eighteen hundred and ninety-three, the same and no other shall be used in determining duties and taxes levied by the United States of America on sheet and plate iron and steel. But this act shall not be construed to increase duties upon any articles which may be imported.

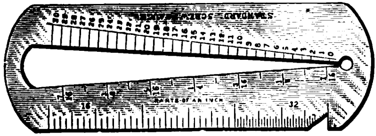
SEC. 3. That in the practical use and application of the standard gauge hereby established a variation of two and one-half per cent. either way may be allowed.

Ap[illegible] arch 3, 1893.

POCKET
SCREW AND WIRE GAUGE.

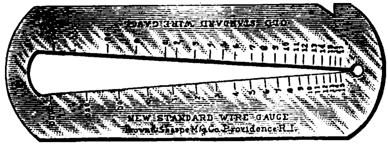
No. 760. Price, $2 50.

Front Side.



Cuts One-half Size.

Back Side.



This gauge as shown is an angular gauge graduated on the front, on the left of slot, to show all sizes of the American standard screw gauge from 0 to 30, and is designed for the measurement of wire as well as of machine and wood screws.

A screw or wire is measured by passing it into the angular opening till it touches on both sides; the division at the point of contact indicates the number of the gauge stamped on the side of the slot.

In addition to the gauge numbers, the front side of the gauge is also graduated on the left of slot to 32nds of an inch.

The back side of gauge is graduated as the old or English wire gauge, from 17 to 0000 on the right, and the new or American wire gauge from 15 to 0000 on the left of slot.

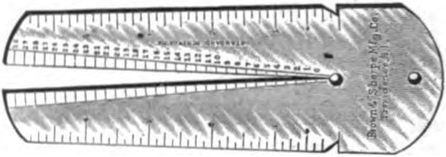
By reason of its weight and size and the fact that the ends are closed, it is especially well adapted to be carried in the pocket.

LARGE SCREW AND WIRE GAUGE.

No. 762. Price, $3 50.

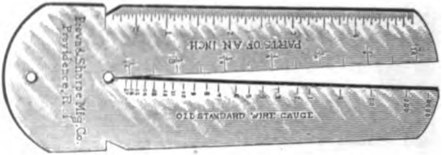
No. 764. Extra Thick, $4 50.

Front Side.



Cuts one-third size.

Back Side.



This gauge, as shown in cut, is graduated on both sides of slot to show all sizes of the American standard screw gauge from 0 to 30, and is designed for the measurement of wire as well as of machine and wood screws.

A screw or wire is measured by passing it into the angular opening till it touches on both sides; the division at the point of contact indicates the number of the gauge stamped on the side of the slot.

The front of the gauge is also graduated on both edges to 8ths of an inch. An angle cut in the side allows the head of the screw to be placed against a positive stop when measuring the length.

The back of the gauge is graduated at the old or English wire gauge from 17 to 0000, on the right, and to 32nds of an inch on the left of slot. The outer left hand edge is graduated to 32nds of an inch.

The larger size makes coarser graduations on the sides of the slot possible, and it is thus more easily read and is best adapted for use when it is to be kept as a tool of reference.

The gauge is also made about 5-32" thick, and is known as "Extra Thick."

TABLE OF DECIMAL EQUIVALENTS OF SCREW GAUGE

FOR MACHINE AND WOOD SCREWS.

The difference between consecutive sizes is .01316".

No. of Screw Gauge.	Size of Number in Decimals.	No. of Screw Gauge.	Size of Number in Decimals.	No. of Screw Gauge.	Size of Number in Decimals.
000	.03152	16	.26840	34	.50528
00	.04468	17	.28156	35	.51844
0	.05784	18	.29472	36	.53160
1	.07100	19	.30788	37	.54476
2	.08416	20	.32104	38	.55792
3	.09732	21	.33420	39	.57108
4	.11048	22	.34736	40	.58424
5	.12364	23	.36052	41	-59740
6	.13680	24	.37368	42	.61056
7	.14996	25	.38684	43	.62372
8	.16312	26	.40000	44	.63688
9	.17628	27	.41316	45	.65004
10	.18944	28	.42632	46	.66320
11	.20260	29	.43948	47	.67636
12	.21576	30	.45264	48	.68952
13	.22892	31	.46580	49	.70268
14	.24208	32	.47896	50	.71584
15	.25524	33	.49212		

TABLE OF DECIMAL EQUIVALENTS
OF STUBS' STEEL WIRE GAUGE.

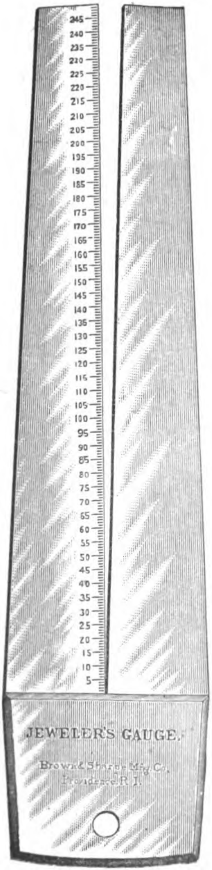
Letter.	Size of Letter in Decimals.	No. of Wire Gauge.	Size of Number in Decimals.	No. of Wire Gauge.	Size of Number in Decimals.	No. of Wire Gauge.	Size of Number in Decimals.
Z	.413	1	.227	28	.139	55	.050
Y	.404	2	.219	29	.134	56	.045
X	.397	3	.212	30	.127	57	.042
W	.386	4	.207	31	.120	58	.041
V	.377	5	.204	32	.115	59	.040
U	.368	6	.201	33	.112	60	.039
T	.358	7	.199	34	.110	61	.038
S	.348	8	.197	35	.108	62	.037
R	.339	9	.194	36	.106	63	.036
Q	.332	10	.191	37	.103	64	.035
P	.323	11	.188	38	.101	65	.033
O	.316	12	.185	39	.099	66	.032
N	.302	13	.182	40	.097	67	.031
M	.295	14	.180	41	.095	68	.030
L	.290	15	.178	42	.092	69	.029
K	.281	16	.175	43	.088	70	.027
J	.277	17	.172	44	.085	71	.026
I	.272	18	.168	45	.081	72	.024
H	.266	19	.164	46	.079	73	.023
G	.261	20	.161	47	.077	74	.022
F	.257	21	.157	48	.075	75	.020
E	.250	22	.155	49	.072	76	.018
D	.246	23	.153	50	.069	77	.016
C	.242	24	.151	51	.066	78	.015
B	.238	25	.148	52	.063	79	.014
A	.234	26	.146	53	.058	80	.013
		27	.143	54	.055		

STUBS' GAUGES.

In using the gauges known as Stubs' Gauges, there should be constantly borne in mind the difference between the Stubs' Iron Wire Gauge and the Stubs' Steel Wire Gauge.

The Stubs' Iron Wire Gauge is the one commonly known as the English Standard Wire, or Birmingham Gauge, and designates the Stubs' *soft* wire sizes.

The Stubs' Steel Wire Gauge is the one that is used in measuring drawn steel wire or drill rods of Stubs' make and is also used by many makers of American drill rods.



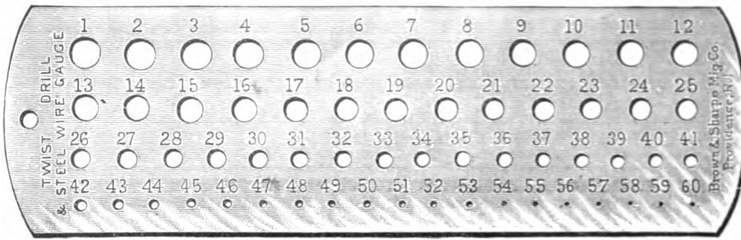
JEWELERS' WIRE GAUGE.

No. 770. - Price, $5 00.

Cut one-half size.

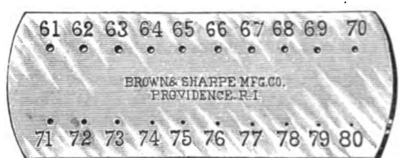
These Gauges are made with reference to the wants of Manufacturing Jewelers. One edge of the angular slot is graduated into 250 parts, and figured to give the size in thousandths of an inch. For example, a size of wire which passes down half-way into the slot, and stops opposite 125, is $\frac{125}{1000}$ of an inch in diameter. The angular slot has no sharp edge to injure the stock gauged.

TWIST DRILL AND STEEL WIRE GAUGES.



Three-quarters Size.

No. 774. Gauge Numbers from 1 to 60. Price, $1 50.



Full Size.

No. 776. Gauge Numbers from 61 to 80. Price, $2 00.

These Gauges are usually sent out finished black but are sent polished when desired.

DECIMAL EQUIVALENTS

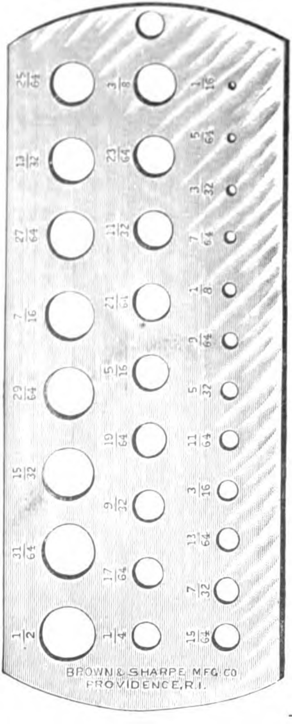
OF THE

Numbers of Twist Drill and Steel Wire Gauge.

No.	Size of No. in Decimals.	No.	Size of No. in Decimals.	No.	Size of No. in Decimals.	No.	Sixe of No. in Decimals
1	.2280	21	.1590	41	.0960	61	0.390
2	.2210	22	.1570	42	.0935	62	.0380
3	.2130	23	.1540	43	.0890	63	.0370
4	.2090	24	.1520	44	.0860	64	.0360
5	.2055	25	.1495	45	.0820	65	.0350
6	.2040	26	.1470	46	.0810	66	.0330
7	.2010	27	.1440	47	.0785	67	.0320
8	.1990	28	.1405	48	.0760	68	.0310
9	.1960	29	.1360	49	.0730	69	.02925
10	.1935	30	.1285	50	.0700	70	.0280
11	.1910	31	.1200	51	.0670	71	.0260
12	.1890	32	.1160	52	.0635	72	.0250
13	.1850	33	.1130	53	.0595	73	.0240
14	.1820	34	.1110	54	.0550	74	.0225
15	.1800	35	.1100	55	.0520	75	.0210
16	.1770	36	.1065	56	.0465	76	.0200
17	.1730	37	.1040	57	.0430	77	.0180
18	.1695	38	.1015	58	.0420	78	.0160
19	.1660	39	.0995	59	.0410	79	.0145
20	.1610	40	.0980	60	.0400	80	.0135

JOBBERS' DRILL GAUGE.

For Gauging Twist Drills.



No. 780.

Price, $2 25.

This Gauge is sent out finished black but will be sent polished if desired.

Equivalents of Sizes in Decimal Parts of an Inch.

Size.	Dec.	Size.	Dec.
1-16	.0625	19-64	.29687
5-64	.07812	5-16	.3125
3-32	.09375	21-64	.32812
7-64	.10937	11-32	.34375
1-8	.125	23-64	.35937
9-64	.14062	3-8	.375
5-32	.15625	25-64	.39062
11-64	.17187	13-32	.40625
3-16	.1875	27-64	.42187
13-64	.20312	7-16	.4375
7-32	.21875	29-64	.45312
15-64	.23437	15-32	.46875
1-4	25	31-64	.48437
17-64	.26562	1-2	.50
9-32	.28125		

SIZES OF TAP DRILLS FOR U. S. STANDARD THREADS.

By the formulas given below, the results, strictly speaking, are the diameters of the bottoms of the threads. The tap drill is, in common practice, the one that is one or two gauge numbers larger, for the smaller, or numbered sizes, and one that is about .500" larger for the larger sizes. The amount allowed for clearance varies in different shops and on different classes of work.

Size of Tap Drill for U. S. Standard Thread = outside diameter of Screw $- \dfrac{1.299}{\text{Threads to the inch.}}$

Size of Tap Drill for 3-4" Screw, U. S. Standard Thread, 10 threads to the inch $= .750 - \dfrac{1.299}{10} = .750 - .1299 = .6201$, size of Tap Drill.

Diameter of Screw.	Threads per Inch.	Size of Tap Drill.	Diameter of Screw.	Threads per Inch.	Size of Tap Drill.
1-4"	20	.185	2	4 1-2	1.712
5-16	18	.240	2 1-4	4 1-2	1.962
3-8	16	.294	2 1-2	4	2.176
7-16	14	.344	2 3-4	4	2.426
1-2	13	.400	3	3 1-2	2.629
9-16	12	.454	3 1-4	3 1-2	2.879
5-8	11	.507	3 1-2	3 3-4	3.100
3-4	10	.620	3 3-4	3	3.317
7-8	9	.731	4	3	3.567
1	8	.837	4 1-4	2 7-8	3.798
1 1-8	7	.940	4 1-2	2 3-4	4.028
1 1-4	7	1.065	4 3-4	2 5-8	4.256
1 3-8	6	1.160	5	2 1-2	4.480
1 1-2	6	1.284	5 1-4	2 1-2	4.730
1 5-8	5 1-2	1.389	5 1-2	2 3-8	4.953
1 3-4	5	1.491	5 3-4	2 3-8	5.203
1 7-8	5	1.616	6	2 1-4	5.423

SIZES OF TAP DRILLS FOR V THREADS.

Size of Tap Drill for V Thread = outside diameter of Screw $- \dfrac{1.732}{\text{Threads to the inch.}}$

Size of Tap Drill for 3-4" V Thread, 10 threads to the inch = $.750 - \dfrac{1.732}{10} = .750 - .1732 = .5768$, size of Tap Drill.

GAS HEATER.

No. 726. Price, 75 Cents.

For Tempering Drills, Punches, Chisels, Small Tools, Etc.

This heater, in many instances, takes the place of a forge in tempering machinists' small tools, and is more convenient and economical in time and fuel. It is provided with a collar with holes corresponding to those in the lower part of the tube. By this arrangement the supply of air can be regulated, and the intensity of the flame controlled.

DIRECTIONS.

In all cases the collar should, before lighting, be turned to nearly close the holes in order to prevent the passage of air into the burner. It should then be turned back, admitting the air until the blue flame appears.

If the gas pressure is low, or a strong draught causes the flame to burn at the bottom instead of at the mouth of the tube, the collar should be adjusted so as to partially shut off the supply of air.

For ordinary work sufficient gas should be used to prevent the flame from descending into the tube, and for larger pieces the flame should be nearly 3 inches wide.

Ordinary articles should be held in the upper part of the flame above the central blue portion and parallel with it. The larger the piece the farther it should extend into the flame.

The heater should be located in a dark place, and a support provided for greater convenience in heating the heavier articles. The upper ends of the curved side pieces should not be more than one-quarter of an inch apart.

The difficulties experienced in using Wire Gauges of the usual forms are well set forth in the following circular issued by **MESSRS. MILLER, METCALF & PARKIN,** *Steel Manufacturers, of Pittsburgh, Pa.*

MEMORANDUM ON GAUGES.

Referring to the annexed tables, we would call attention to some of the absurdities and anomalies of the present system of gauges, denoted by numbers.

A perusal of these tables should satisfy us that we have a sufficient variety to choose from and ample refinement, when we get down to one-millionth of an inch, which is the final figure in some cases.

In some cases the difference between two numbers falls as low as two one-thousandths of an inch, in others it is only one one-thousandth, &c.

It may be possible to make one gauge to any of these standards, which shall be so accurate as to defy the detection of an error and with the same care it may be possible to make a thousand such gauges, but every mechanic and every person accustomed to making accurate measurements of the best work, knows that it is simply impossible to obtain absolute accuracy in such pieces of work, when produced in large quantities.

It is impossible commercially, on account of the cost and that settles the question.

Every one knows of the wonderful accuracy of the Whitworth gauges and also their enormous price, which makes them almost unsalable.

In regard to ordinary wire gauges, they are notoriously inaccurate, because they cannot be made accurate and be at all salable.

We have two new gauges in our possession, which were kept in our offices for purposes of comparison and to prevent their wearing they were not allowed to go into the mills.

In a recent case, a sample under discussion, measured on one gauge, tight twenty-three, and on the other, light twenty-four and our customer said it was neither, by his gauge and did not suit him, anyhow.

One of our new gauges has its No. 23 so much larger than its No. 22, that the difference can be easily detected by the naked eye; yet No. 23 ought to be two to four thousandths smaller than No. 22.

If we were to roll No. 23 by that gauge, how would our customer get what he wanted, unless his gauge accidentally contained the same blunder? Yet our gauge is a new one stamped with the maker's name, and cost about six doll[illegible]

[illegible] trouble [illegible] with the wearing of the gauges, for [illegible] and we imagine that no man [illegible] gauge because it is worn out. On the [illegible] dollars; he is used [illegible] and he is not when [illegible] measure [illegible]. A still more serious [illegible] common mode of ordering [illegible] such a gauge, "light" or [illegible] "heavy" or "easy," or such a [illegible] instance 5 [illegible].

[illegible] confusing to a roller; he almost [illegible] thicker than the [illegible] certain to make [illegible] the [illegible] command.

[illegible] "light," "easy," &c., we [illegible] the differences between Nos. 27 and 28, [illegible] as follows:—

[illegible] [illegible] [illegible]

[illegible] twenty-five one-hundred-thousandths, [illegible] thousandths and fifteen hundred and fifty-four [illegible].

[illegible] possible for a roller to know just how many [illegible] another man, whom he never saw, [illegible] or No. 27 "easy" and [illegible] how many thousandths of an inch the [illegible] wrong in its make, or how many [illegible] years of steady use? This is no [illegible] difficulties in this [illegible] knows just what he wants and will [illegible] no better way of telling his [illegible] want such a gauge "light," when [illegible] gauge differs from every other gauge that was [illegible].

[illegible] easy and simple way out of this whole [illegible] that is to abandon fixed gauges and numbers [illegible].

[illegible] Sheet Metal Gauges, made by the Brown & Sharpe Manufacturing Co., of Providence, R. I., cost less [illegible] no more. They measure thousandths [illegible] and even a quarter of a [illegible] measured.

[illegible] so that any boy of ordinary intelligence can be taught to use one in a very few minutes. They have very easy arrangements for re-adjustment, when worn and even when worn considerably, they can be used [illegible] without adjustment, by making allowance for the error in reading at the zero line.

We find that mechanics like to work to them and that there is very little trouble to get sheet rolling done to within a thousandth of an inch on fine sizes.

Our works are fully supplied with these instruments and *we urge* all parties in ordering to give us dimensions and *not numbers.*

We cannot now recall a single case of serious complaint *having arisen* where we have had dimensions expressed in *decimals* to work to.

WEIGHT OF IRON AND STEEL SHEETS.

Weight Per Square Foot.—*Kent.*

Thickness by Birmingham Gauge.				Thickness by American (Brown & Sharpe's) Gauge.			
No. of Gauge.	Thickness in Inches.	Iron.	Steel.	No. of Gauge.	Thickness in Inches.	Iron.	Steel.
0000	.454	18.16	18.52	0000	.46	18.40	18.77
000	.425	17.00	17.34	000	.4096	16.38	16.71
00	.38	15.20	15.30	00	.3648	14.59	14.88
0	.34	13.60	13.87	0	.3249	13.00	13.26
1	.3	12.00	12.24	1	.2893	11.57	11.80
2	.284	11.36	11.59	2	.2576	10.30	10.51
3	.259	10.36	10.57	3	.2294	9.18	9.36
4	.238	9.52	9.71	4	.2043	8.17	8.34
5	.22	8.80	8.98	5	.1819	7.28	7.42
6	.203	8.12	8.28	6	.1620	6.48	6 61
7	.18	7.20	7.34	7	.1443	5.77	5.89
8	.165	6.60	6.73	8	.1285	5.14	5.24
9	.148	5.92	6 04	9	.1144	4.58	4.67
10	.134	5.36	5.47	10	.1019	4.08	4.16
11	.12	4.80	4.90	11	.0907	3.63	3.70
12	.109	4.36	4.45	12	.0808	3.23	3.30
13	.095	3.80	3.88	13	.0720	2.88	2.94
14	.083	3.32	3.39	14	.0641	2.56	2.62
15	.072	2.88	2.94	15	.0571	2.28	2.33
16	.065	2.60	2.65	16	.0508	2.03	2.07
17	.058	2.32	2.37	17	.0453	1.81	1.85
18	.049	1.96	2.00	18	.0403	1.61	1.64
19	.042	1.68	1.71	19	.0359	1.44	1.46
20	.035	1.40	1.43	20	.0320	1.28	1.31
21	.032	1 28	1.31	21	.0285	1.14	1.16
22	.028	1.12	1.14	22	.0253	1.01	1.03
23	.025	1.00	1.02	23	.0226	.904	.922
24	.022	.88	.898	24	.0201	.804	.820
25	.02	.80	.816	25	.0179	.716	.730
26	.018	.72	.734	26	.0159	.636	.649
27	.016	.64	.653	27	.0142	.568	.579
28	.014	.56	.571	28	.0126	.504	.514
29	.013	.52	.530	29	.0113	.452	.461
30	.012	.48	.490	30	.0100	.400	.408
31	.01	.40	.408	31	.0089	.356	.363
32	.009	.36	.367	32	.0080	.320	.326
33	.008	.32	.326	33	.0071	.284	.290
34	.007	.28	.286	34	.0063	.252	.257
35	.005	.20	.204	35	.0056	.224	.228

	Iron.	Steel.
Specific gravity	7.7	7.854
Weight per cubic foot	480.	489.6
Weight per cubic inch	.2778	.2833

As there are many gauges in use differing from each other and even the thicknesses of a certain specified gauge, as the Birmingham, are not assumed the same by all manufacturers, orders for sheets and wires should state the weight per square foot or the thickness in thousandths of

TELEGRAPHIC CODE.

TELEGRAPHIC ADDRESS, "SHARPE, PROVIDENCE."

This Code was adopted for the use and convenience of our correspondents. We have in addition copies of the "A, B, C, Telegraphic Code," "Lieber's Code," and "Western Union Telegraphic Code and Cable Directory."

How many?	Abnegate.
As soon as possible	Admiration.
What is the price of?	Affray.
Send floor plan of	Affix.
This price includes overhead works and everything shown in cut, boxed and delivered f. o. b. Providence, R. I., and is net cash	After.
Should you order, please arrange for payment with some banker in New York or enclose sight draft with your order	Agate.
Has there been any change in the price of?	Agile.
Extra expense will be	Alpheus.
Total amount	Alderman.
What will be the weight of?	Aluminum.
How soon can you ship?	Antilles.
Can you furnish before	Antler.
We cannot furnish	Anxious.
Replaced by new design	Anxiety.
We would recommend.	Aonian.
If so we enter order	Aorist.
Have you shipped?	Aortaley.
We will ship	Apace.
We hope to ship about	Apatels.
We can ship immediately	Apend.
We hope to ship	Apante.
We can ship — days after receipt of order	Apathy.
Shall we ship?	Apepsy.
How soon can you ship, and what is the price of?	Aperture.
If ordered at once we can ship	Apetalons.
Order received, cannot ship until about	Apevopi.
We can ship	Apex.
We cannot ship until funds are received	Aphanite.
When did you ship?	Appraise.
May we ship by	Approach.
Ship by express	Apron.
Ship by fast freight	Apsolt.
We will ship immediately	Apthong.
Send tracer for	Aquiline.
Send by mail	Arabian.
Send by parcel post	Aracca.
By what line have you shipped?	Armour.
Shipped as per your instructions	Athens.
Shipped by steamer [illegible] New York	Athesis.

Shipped by steamer leaving Boston	Atilla.
Will ship by steamer leaving New York . . .	Atinia.
Will ship by steamer leaving Boston	Atlin.
We have written you on the subject	Aunt.
We are shipping to-day —	Auportes.
We shipped yesterday	Auposely.
How shall we ship?	Auracestu.
Ship by American Line	Aurade.
Ship by Hamburg-American Line via New York	Auralet.
Ship by Allan Line via Boston	Aurich.
Ship by Allan State Line via New York . . .	Aurora.
Ship by Cunard Line via New York	Austrian.
Ship by Cunard Line via Boston	Austunt.
Ship by Anchor Line	Aversion.
Ship by Wilson Line via New York	Avoset.
Ship by Wilson Line via Boston.	Avult.
Ship by Warren Line	Awake.
Ship by White Star Line	Barbarity.
Ship by Red Star Line	Boom.
Ship by Leyland Line via New York	Border.
Ship by Leyland Line via Boston	Boswain.
Ship by North German Lloyd	Burgundy.
Ship by North German Lloyd to Genoa . .	Burnos.
Ship by North German Lloyd to Naples . .	Burletta.
Ship by Compagnie Generale Transatlantique	Carpet.
Ship by Scandanavian Am. Line to Copenhagen	Carpial.
Ship by Scandanavian Am. Line to Gothenburg	Carpusty.
Ship by Scandanavian Am. Line to Stockholm	Carrara.
Ship to the care of	Carroll.
Delivery f. o. b. Providence	Cartoon.
Delivery f. o. b. New York	Charm.
Delivery f. o. b. Boston	Chlorate.
To be delivered not later than	Clan.
To be called for in New York	Clausel.
According to instructions	Compare.
We sold before your instructions were received	Consider.
Do you wish any-stock small and demand good	Convex.
Others reserved no longer	Convoke.
We have not in stock the machine you order, but will send it	Creed.
We have not in stock the machine you order, but can send it	Croix.
We have not in stock the machine you order, but can ship immediately	Drug.
We have not in stock the machine you ask for but can ship	Easter.
Machine damaged between our works and steamer. Will send another to replace by steamer sailing —	Egeria.
Shall we do so?	Egotist.
Please reply to our letter of — concerning .	Elect.
Acknowledge receipt of letter (telegram or cable) by telegraph or cable	Electuse.
When can you fill our order of —?	Eleph[illegible]
Please refer to letter of	[illegible]
Order received	[illegible]

Order executed as per instructions	Florence.
Hold subject to our order	Fork.
Have order for—Await letter before shipping	Formet.
Add to our order	Frock.
Send what you can of our order at once; let balance follow as soon as possible . . .	Garlic.
We are doing all we can to hurry your order, hope to send it —	Garrison.
Will there be any fine for delay? If so, how much?	General.
Do nothing until you hear from us	Gilead.
Do nothing further in the matter	Gilpin.
Has letter been received?	Gimlet.
Your letter has not been received	Giraffe.
Your letter has been received and contents are satisfactory	Gird.
Wait for our letter before taking definite action	Gizzard.
Waiting for your instructions	Grant.
Make best settlement possible and we will stand loss	Grape.
Enter our order for the following machine(s) —, and hold it (them) subject to our instructions	Gratiant.
Do you want?	Gratidia.
Cannot hold longer except for definite order.	Grattant.
If wanted you must order at once	Grayling.
None on hand	Grass.
None on hand or in process of manufacture .	Grassmere
None on hand, and no more will be made . .	Greaves.
We give you telegraphic refusal subject to your replying within forty-eight hours .	Guide.
Can we do anything for you?	Lagoda.
Answer by cable or telegram	Polish.
Send particulars by mail	Primer.
You will receive letter of instructions . . .	Produce.
Letter received; will act on your instructions	Prolix.
Cannot comply	Pulley.
Decline to have anything to do with the matter	Pulsation.
The best we can do	Pupil.
What will be satisfactory?	Purple.
We do not know what you mean	Push.
Placed the amount to your credit with . . .	Putnam.
Your bankers state they have received no instructions from you to pay our bill . .	Puxton.
Balance to your credit is	Quaint.
Has been received	Queerest.
Shall we attend to insurance?	Queen.
Insure for amount of invoice	Quibble.
Need not insure	Rabid.
Send sample of work which machine is to make	Rasp.
Have sent sample of work which machine is to make	Rate.
Waiting for samples	Ramee.
Samples not received	Ramose.
We will reserve you for 10 days	Ranch.
We will reserve you for 20 days	Random.

Send latest catalogue	Rainbow
Send supply latest edition General Catalogue	Rayport.
Send supply latest edition Machinist Tool Catalogue	Rakem.
Apply to our agents, Messrs. Buck & Hickman, Ltd., 2 & 4 Whitechapel Road, London, E., England	Road.
Apply to our agents, Messrs. Chas. Churchill & Co., Ltd., 9 to 15 Leonard St., Finsbury, London, E. C., England	Run.
Apply to our agents, Messrs. Buck and Hickman, Ltd., 2 & 4 Whitechapel Road, London, E., England, or to Messrs. Chas. Churchill & Co., Ltd., 9 to 15 Leonard St., Finsbury, London, E. C., England	Rush.
Apply to our agents, Messrs. Fenwick Freres & Co., 21 Rue Martel, Paris, France . . .	Sail.
Apply to our agent, Otto Diechmann, Berlin, N. W. 7, Friedcrichstrasse, 138	Saint.
Apply to our agents for small tools, Messrs. Schuchardt & Schuette, Spandauerstr. 59 to 61, Berlin, C.	Sap.
Apply to our agent, V. Loewener, Copenhagen, K	Sardls.
Apply to our agents, J. Block Co., Moscow and St. Petersburg, Russia	Saydow.
Apply to our agent, F. W. Horne, 70C, Yokohama	Savoy.

MACHINES.

UNIVERSAL MILLING MACHINES.

No. 1 without Tools	Adents.
No. 1 with Tools	Adeona.
No. 1 1-2 without Tools	Ader.
No. 1 1-2 with Tools	Adida.
No. 2 with Hand Vertical Feed, without Tools	Adolph.
No. 2 with Hand Vertical Feed, with Tools	Albert.
No. 2 with Power Vertical Feed, without Tools	Alberoni.
No. 2 with Power Vertical Feed, with Tools	Albertuts.
No. 2A with Hand Vertical Feed, without Tools	Ancaniz.
No. 2A with Hand Vertical Feed, with Tools	Alcesti.
No. 2A with Power Vertical Feed, without Tools	Alcuine.
No. 2A with Power Vertical Feed, with Tools	Aldusty.
No. 3 without Tools	Alcon.
No. 3 with Tools	Aleus.
No. 4 without Tools	Amelot.
No. 4 with Tools	Amelotto.

ATTACHMENTS FOR MILLING MACHINES.

Taper Milling Attachment for Nos. 1 and 1 1-2 Univ. Mill. Mchs.	Amari.
Taper Milling Attachment for Nos. 2 and 2 A Univ. Mill. Mch.	Amey.
Hand Milling Attachment for No. 0 Plain Milling Machine, with Rack Feed .	Amos.
Gear Cutting Attachment	Anaxo.
Rack Cutting Attachments.	
No. 10	Arisel.
No. 11	Arkitel.
No. 12	Arklaws.
No. 12A	Arkbest.
Indexing Attachments for use with Rack Cutting Attachments.	
No. 10	Arlberg.
No. 11	Arles.
No. 12	Arlington.
High Speed Milling Attachments.	
No. 10	Armagh.
No. 11	Armenia.
No. 12	Armenust.
Vertical Spindle Milling Attachments.	
No. 9, for No. 0 Plain Mill. Mch. . . .	Artigas.
No. 10, for Nos. 1, 1 1-2, 2 and 2A Univ., Nos. 1, 1B, 2 and 2B Plain Mill. Mchs.	Asaph.
No. 11, for No. 3 Univ. or No. 3 Plain Mill. Mchs.	Aser.
No. 12, for No. 4 Univ. or No. 4 Plain Mill. Mchs.	Asti.
No. 12A, for No. 24 Plain Mill. Mchs. .	Astoria.
No. 13, for No. 5 Plain Mill. Mch. . .	Atri.
Universal Milling Attachment.	
No. 12, for No. 4 Univ. and No. 4 Plain Mill. Mchs.	Ayrshire.
Slotting Attachments.	
No. 9, for No. 0 Plain Mill. Mch. . . .	Axiust.
No. 10, for Nos. 1, 1 1-2, 2 and 2A Univ., Nos. 1, 1B, 2 and 2B Plain Mill. Mchs.	Axooms.
No. 11, for No. 3 Univ., No. 3 Plain Mill. Mchs.	Axopum.
No. 12, for No. 4 Univ., No. 4 Plain Mill. Mchs.	Axopumles.
No. 12A, for No. 24 Plain Mill. Machine .	Axuront.
Circular Milling Attachment, 18", with Hand Feed	Ayala.
Circular Milling Attachment, 18", with Power Feed	Ayolent.
Circular Milling and Dividing Attach., 10" .	Ayscough.
Cam Cutting Attachment.	
No. 10, for Nos. 1, 1 1-2 and 2 Univ., Nos. 1 and 2 Plain Mill. Mchs.	Ayamonte.
Scale and Vernier for Univ. Mill. Mchs. .	Ayton.

INDEX CENTRES.

12 1-2 inch Universal, without Table	Azaran.
12 1-2 " " with "	Azariah.
10 " " without "	Azastul.
10 " " with "	Azately.
4 3-4 inch Index Centres	Azaz.
10 " " " without Table	Azides.
10 " " " with "	Azilistasy.
12 " " " without "	Azotus.
12 inch Index Centres, with Table	Azrikamo.
8 inch Single Dial Index Centres, Foot-stock with Bearing, without Table	Azzo.
8 inch Single Dial Index Centres, Foot-stock with Bearing, with Table	Azbazareth.
8 inch Single Dial Index Centres, Foot-stock with Adjustable Centre, without Table	Azbuk.
8 inch Single Dial Index Centres, Foot-stock with Adjustable Centre, with Table	Azglion.
12 inch Single Dial Index Centres, Foot-stock with Bearing, without Table	Azekah.
12 inch Single Dial Index Centres, Foot-stock with Bearing, with Table	Azenstiles
12 inch Single Dial Index Centres, Foot-stock with Adjustable Centre, without Table	Azezal.
12 inch Single Dial Index Centres, Foot-stock with Adjustable Centre, with Table	Azetasl.
No. 14 Triple Index Centres	Azetmist.
No. 2 1-2 Triple Index Centres for Direct Indexing, only	Azetrain.
No. 4 Triple Index Centres for Direct Indexing, only	Azetruly.

TABLES FOR INDEX CENTRES.

For 8 inch Single Dial, 10 inch Plain and 10 inch Universal	Azerbain.
For 12 inch Single Dial and 12 inch Plain	Azetas.
For 12 1-2 inch Universal	Azeupats.

VISES.

Adjustable Swivel Vise for No. 2 Surface Grinding Machine	Azgets.
Plain Vises.	
No. 1	Azgilost.
No. 2	Azgomen.
No. 3	Azgopur.
Flanged Vises.	
No. 1	Azgorunt.
No. 2	Azgostut.
No. 3	Azgoturni.
No. 4	Azhamput.
Swivel Vises.	
No. 2	Azhalty.
No. 3	Azhalpesty.
Tool Makers' Universal Vise, No. 2	Azhalquic.
Tool Makers' Universal Vise, No. 3	Azotus.
IMPROVED BENCH CENTRES, with Indicator	Azel.
IMPROVED BENCH CENTRES, without Indicator	Azgad.

SETS OF TOOLS FOR MILLING MACHINES.

No. 1 Universal Milling Machine . . .	Azhand.
Nos. 1 1 2, 2 and 2A Univ. Milling Machines	Azillis.
No. 3 Universal Milling Machine . . .	Azilurst.
No. 4 " " " . . .	Azmaves.
No. 00 Hand Milling Machine	Azoruske.
No. 0 Plain Milling Machine, Screw Feed .	Azriel.
Nos. 1 and 2 Plain Milling Machines . .	Azrimuh.
Nos. 1B and 2B Plain Milling Machines .	Azrital.
No. 3 " " " . . .	Azroban.
No. 4 or 24 " " " . . .	Azroco.
No. 5 " " " . . .	Azrocump
No. 2 Vertical Spindle Milling Machine. .	Caduley.
No. 5 " " " " .	Aztumly.

PLAIN MILLING MACHINES.

No. 00 Hand, without Tools	Bahadur.
No. 00 " with "	Bahurime.
No. 0 Rack Feed, without Tools	Baidy.
No. 0 Screw " " "	Baja.
No. 0 " " with "	Bajazet.
No. 1 Rack " without "	Balbec.
No. 1 " " with "	Ballou.
No. 1 Screw " without "	Baltic.
No. 1 " " with "	Barnes.
No. 1B, without Tools	Baroachy.
No. 1B, with "	Barodiset.
No. 2 Rack Feed, without "	Batia.
No. 2 " " with "	Bayard.
No. 2 Screw " without "	Bazlith.
No. 2 " " with "	Bealia.
No. 2B, without Tools	Beatoun.
No. 2B, with "	Beaucham.
No. 3 Rack Feed, without Tools, without Pump	Bede.
No. 3 Rack Feed, with Tools, without Pump	Biel.
No. 3 " " without Tools, with Pump	Bila.
No. 3 " " with Pump, with Tools .	Bilahs.
No. 3 Screw Feed, without Tools, without Pump	Bilbills.
No. 3 Screw Feed, with Tools, without Pump	Bileam.
No. 3 " " without Tools, with Pump	Billaut.
No. 3 " " with Tools, with Pump .	Billeric.
No. 4 without Tools, without Pump . .	Birsha.
No. 4 with Tools, without Pump . . .	Bisanthe.
No. 4 without Tools, with Pump . . .	Bistonia.
No. 4 with Tools, with Pump	Biton.
No. 5 with Hand Vertical Feed, without Tools, without Pump	Blaena.
No. 5 with Hand Vertical Feed, with Tools, without Pump	Blastus.
No. 5 with Hand Vertical Feed, without Tools, with Pump	Bligh.
No. 5 with Hand Vertical Feed, with Tools, with Pump	Boaz.

PLAIN MILLING MACHINES—*Continued*

No. 5 with Power Vertical Feed, without Tools, without Pump	Bocgey.
No. 5 with Power Vertical Feed, with Tools, without Pump	Boccalina
No. 5 with Power Vertical Feed, without Tools, with Pump	Boduni.
No. 5 with Power Vertical Feed, with Tools, with Pump	Boethia.
No. 12 without Pump	Brayton.
No. 12 with "	Brazil.
No. 13 without Pump	Bruhl.
No. 13 with "	Brunck.
No. 13 with Compound Back Gears, without Pump	Brueys.
No. 13 with Compound Back Gears, with Pump	Brumoy.
No. 13B, without Pump	Brunnley
No. 13B, with "	Bruties.
No. 24, without Tools, without Pump . .	Byron.
No. 24, with Tools, without Pump . . .	Byrrhus.
No. 24, without Tools, with Pump . . .	Byshe.
No. 24, with Tools, with Pump . . .	Byzenus.
With Metric Screw	Byza.
With Power Vertical Feed	Bubastis.
With Hand Vertical Feed	Buchan.
Do you wish Hand or Power Vertical Feed?	Bucolica.

VERTICAL SPINDLE MILLING MACHINES.

No. 2, without Tools, without Circular Milling Attachment	Cabades.
No. 2, with Tools, without Circular Milling Attachment	Cabbon.
No. 2, without Tools, with Circular Milling Attachment, with Power Feed . .	Caballey.
No. 2, without Tools, with Circular Milling Attachment, with Hand Feed . . .	Cabinda.
No. 2, with Tools, with Circular Milling Attachment, with Power Feed . .	Cabirise.
No. 2, with Tools, with Circular Milling Attachment, with Hand Feed . . .	Cabrera.
Circular Milling Attachment for No. 2 Vertical Spindle Milling Machine with Hand Feed	Ayala.
Circular Milling Attachment for No. 2 Vertical Spindle Milling Machine with Power Feed	Ayolent.
No. 5, without Tools, without Circular Milling Attachment . . . . , . .	Caesar.
No. 5, with Tools, without Circular Milling Attachment	Carl.
No. 5, without Tools, with Circular Milling Attachment	Carmel.
No. 5, with Circular Milling Attachment, with Tools	Carnot.
Circular Milling Attachment, for No. 5 Vertical Spindle Milling Machine . . .	Charles.

SODA KETTLE, Round Top.	Donald.
SODA KETTLE, Semi-Round Top . . .	Duval.

PLAIN SCREW MACHINES.

No. 3 Power Feed	Edgar.
No. 3 without Oil Pump	Elbert.
No. 3 with " "	Eldad.
No. 4 or 5 Power Feed	Eldred.
No. 4 without Oil Pump	Eli.
No. 4 with " "	Elijah.
No. 5 without " "	Enos.
No. 5 with " "	Epli.
No. 6 without " " without Tools . .	Eric.
No. 6 with " " " " . .	Eugia.
No. 6 with Tools, without Pump . . .	Eugiton.
No. 6 with Tools, with Pump	Euhydri.

AUTOMATIC SCREW MACHINES.

No. 00	Euler.
No. 0	Eumedes.
No. 2	Harvey.

SCREW SLOTTING ATTACHMENTS.

For No. 00	Hasshub.
For No. 0	Hasupha.
For No. 2	Hatipha.

WIRE FEED SCREW MACHINES.

No. 0 without Tools, without Pump . .	Henlopen.
No. 0 with " " " . .	Henke.
No. 0 without Tools, with Pump . . .	Henniker.
No. 0 with " " " . . .	Henriko.
No. 1 without Tools, without Pump . .	Heraclea.
No. 1 with " " " . .	Hera.
No. 1 without Tools, with Pump . . .	Heracleote.
No. 1 with " " " . . .	Heralut.
No. 2 without Tools, without Pump . .	Hercyna.
No. 2 with " " " . .	Hercens.
No. 2 without Tools, with Pump . . .	Herder.
No. 2 with " " " . . .	Hereford.
No. 2 with Power Feed, without Tools, without Pump	Heriluss.
No. 2 with Power Feed, with Tools, without Pump	Hermesly.
No. 2 with Power Feed, without Tools, with Pump	Hermuse.
No. 2 with Power Feed, with Tools, with Pump	Hernicis.
No. 2 Power Feed	Herodes.
No. 4 without Tools, without Pump . .	Heroisly.
No. 4 with " " " . . .	Herveysal.
No. 4 without Tools, with Pump . . .	Herzegov.
No. 4 with " " " . . .	Heslone.
Three Pulley Countershaft, for Wire Feed Screw Machines	Hesychius

AUTOMATIC GEAR CUTTING MACHINES.

No. 3 to take work to 26" diameter.
- Without Tools, without Pump . . Iacchus.
- With Tools, without Pump . . . Iadeux.
- Without Tools, with Pump . . . Ialmenus.
- With Tools, with Pump . . . . Ialmfest.

No. 3 to take work to 36" diameter.
- Without Tools, without Pump . . Ialmgia.
- With Tools, without Pump . . . Ialmkut.
- Without Tools, with Pump . . . Ialmley.
- With Tools, with Pump . . . . Ialomex.

No. 4 to take work to 36" diameter.
- Without Tools, without Pump . . Iader.
- With Tools, without Pump . . . Ialuset.
- Without Tools, with Pump . . . Ialysus.
- With Tools, with Pump . . . . Ialyuit.

No. 4 to take work to 48" diameter.
- Without Tools, without Pump . . Ialyzria.
- With Tools, without Pump . . . Ialvesop.
- Without Tools, with Pump . . . Ialzeph.
- With Tools, with Pump . . . . Ialzexemy.

No. 5 to take work to 48" diameter.
- Without Tools, without Pump . . Imaxenus.
- With Tools, without Pump . . . Iamteyles.
- Without Tools, with Pump . . . Ianthea.
- With Tools, with Pump . . . . Iantisule.

No. 5 to take work to 60" diameter.
- Without Tools, without Pump . . Ianumth.
- With Tools, without Pump . . . Ianvety.
- Without Tools, with Pump . . . Ianzertets.
- With Tools, with Pump . . . . Ianzerley.

No. 6 to take work to 60" diameter.
- Without Tools, without Pump . . Iaon.
- With Tools, without Pump . . . Iaontey.
- Without Tools, with Pump . . . Iapetus.
- With Tools, with Pump . . . . Iapfult.

No. 6 to take work to 72" diameter.
- Without Tools, without Pump . . Iapidia.
- With Tools, without Pump . . . Iapkets.
- Without Tools, with Pump . . . Iaptust.
- With Tools, with Pump . . . . Iaptustet.

No. 13 without Tools, without Pump . . Iapis.
- Without Tools, with Pump . . . Iapyclia.
- With Tools, without Pump . . . Iapzex.
- With Tools, with Pump . . . . Iapzhit.

SETS OF TOOLS FOR AUTOMATIC GEAR CUTTING MACHINES.

- For Nos. 3 or 13 . . . . Iarchaset.
- For No. 4 . . . . Iaxartes.
- For No. 5 . . . . Iberia.
- For No. 6 . . . . Ibrahim.

INTERNAL GEAR CUTTING ATTACHMENTS

- For No. 3 Automatic Gear Cutting Machine Laonices.
- For No. 4 " " " " Laophon.
- For No. 5 " " " " Laos.
- For No. 6 " " " " Laphaes.

No. 0 AUTO. TURRET FORMING MACHINE .	Xumarkey
No. 2 AUTO. TURRET FORMING MACHINE .	Xanina.
No. 00 AUTO. CUTTING-OFF MACHINE . .	Xumid.
No. 0 AUTOMATIC CUTTING-OFF MACHINE .	Xumidist.
No. 1 AUTOMATIC CUTTING-OFF MACHINE .	Xumets.
GRINDSTONE TROUGH with Stone . . .	Yalden.
GRINDSTONE TROUGH without Stone . .	Yemen.
GRINDSTONE TRUING DEVICE with 7" Roll .	Yoke.
GRINDSTONE TRUING DEVICE with 12" Roll	Yonne.

FURNACES.

No. 1, Iron Work fitted for erection . .	Yssel.
No. 1, Iron Work fitted for erection and Special Tiles	Yucatan.
No. 1, Double, Iron Work fitted for erection	Yuca.
No. 1, Double, Iron Work fitted for erection and Special Tiles	Yudel.
No. 2, Iron Work fitted for erection, Right Hand	Yost.
No. 2, Iron Work fitted for erection, Left Hand	Yosemite.
No. 2, Iron Work fitted for erection and Special Tiles, Right Hand . . .	Youth.
No. 2, Iron Work fitted for erection, and Special Tiles, Left Hand	Youghal.
No. 2, Double, Iron Work fitted for erection	Youats.
No. 2, Double, Iron Work fitted for erection and Special Tiles	Youm.
No. 0 Small Hardening, for Open Fire .	Ypres.
No. 3, Iron Work fitted for erection, Right Hand	Zara.
No. 3, Iron Work fitted for erection, Left Hand	Zantey.
No. 3, Iron Work fitted for erection and Special Tiles, Right Hand . . .	Zebra.
No. 3, Iron Work fitted for erection and Special Tiles, Left Hand	Zebulun.
No. 3, Double, Iron Work fitted for erection	Zair.
No. 3, Double, Iron Work fitted for erection and Special Tiles	Zainge.
No. 4, Iron Work fitted for erection, Right Hand	Zero.
No. 4, Iron Work fitted for erection, Left Hand	Zeuxis.
No. 4, Iron Work fitted for erection and Special Tiles, Right Hand . . .	Zodiac.
No. 4, Iron Work fitted for erection and Special Tiles, Left Hand	Zophav.
No. 4, Double, Iron Work fitted for erection	Zethes.
No. 4, Double, Iron Work fitted for erection and Special Tiles	Zohar.

WORKBENCH, patterns for	Zone.
WORKBENCH, Casting for, drilled ready for use	Zymotic.

AMOUNTS IN DOLLARS.

To obtain an approximately equivalent sum in Pounds Sterling, divide by five.

To obtain an approximately equivalent sum in Francs, multiply by five.

To obtain an approximately equivalent sum in Marks, multiply by four.

In many cases, two words may be combined as one. For example, "Lowmill" would mean 6500 dollars.

1000	North.	100	Bell.
2000	East.	200	Dan.
3000	South.	300	Ken.
4000	West.	400	Long.
5000	High.	500	Mill.
6000	Low.	600	New
7000	Upper.	700	Port.
8000	Alder.	800	Ray.
9000	Apple.	900	Rose.
10000	Box.	10	Brae.
11000	Date.	20	Brook.
12000	Elm.	30	Creek.
13000	Fig.	40	Grade.
14000	Fir.	50	Haven.
15000	Hop.	60	More.
16000	Holly.	70	Town.
17000	Ivy.	80	Vale.
18000	Lemon.	90	Wick.
19000	Maple.	1	Fay.
20000	Oak.	2	Hat.
21000	Palm.	3	Inn.
22000	Peach.	4	Jet.
23000	Pear.	5	Led.
24000	Pine.	6	Sty.
25000	Pink.	7	Urn.
30000	Plum.	8	Vex.
40000	Vine.	9	Wry.
50000	Yew.		

WEIGHTS.

These same words can be used to indicate the weights of machines by writing the letter z at the end of each word or compound word.

For example, "Westbellz" would mean 4100 pounds.

TABLE OF DATES.

We publish the following table by permission of Messrs. E. A. Adams & Co., Boston, Mass., New England Agents of the Red Star Line of Steamers. For example, "Armsberg" would mean first of January.

DATE.	BEGINNING FOR THE DAY.	ENDING FOR THE MONTH.	MONTH.
First	Arms.	Berg	January.
Second	Aron.	Boro	February.
Third	Ash.	Dorf	March.
Fourth	Attle.	Dale	April.
Fifth	Baron.	Field	May.
Sixth	Beach.	Ford	June.
Seventh	Bloom.	Ham	July.
Eighth	Brown.	Mont	August.
Ninth	Barro.	Shire	September.
Tenth	Clark.	Ton	October.
Eleventh	Clay.	Ville	November.
Twelfth	Cake.	Wood	December.
Thirteenth	Cole.		
Fourteenth	Dress.		
Fifteenth	Devon.		
Sixteenth	Dun.		
Seventeenth	Eden.		
Eighteenth	Elgin.		
Nineteentn	Eton.		
Twentieth	Fair.		
Twenty-first	Glen.		
Twenty-second	Green.		
Twenty-third	Hazel.		
Twenty-fourth	Lees.		
Twenty-fifth	Lynn.		
Twenty-sixth	Olden.		
Twenty-seventh	Oster.		
Twenty-eighth	Pitts.		
Twenty-ninth	Plain.		
Thirtieth	Raven.		
Thirty-first	Rock.		

Telegraphic Address, "Sharpe, Providenc